

2006 Arctic Science Conference

*Fairbanks, Alaska
October 2nd - 4th*



State of the Arctic

Current State of the Arctic • Observations and Evaluations of Arctic Change

2006
Arctic Science
Conference



State of the Arctic

Current State of the Arctic Observations and Evaluations of Arctic Change

Fairbanks, Alaska
October 2nd – 4th, 2006

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Cover photograph informaton: The peak of Mount McKinley glows in the early morning sunlight in early November. Credit: Photo © Chris LeDoux

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• *Conference Sponsors* •

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www.ucalgary.ca/aina

• *Conference Organization* •

The Arctic Science Conference is an annual meeting that is organized and supported by the American Association for the Advancement of Science (AAAS) Arctic Division. The locations and themes of the conference vary from year to year, although the themes and locations are always related to the Arctic and the scientific endeavors of the AAAS Arctic Division members and their colleagues. It is a continuing goal of this conference that it be open and accessible to all scientific scholars who are working with Arctic, Alaskan, Canadian, or northern issues, and to reflect their interests and discoveries within the event.

The theme of the 2006 Arctic Science Conference is "State of the Arctic: Current State of the Arctic – Observations of Arctic Change." Although the conference is open to all scientific contributions related to the North and the Arctic, this theme was chosen to emphasize environment and weather related research. This year's conference was organized by:

Conference Organizers

Conference Chair

John Walsh, President, Arctic Division, AAAS, www.arctic.aaas.org

Conference Coordinator

Arthur Roraff, The Coordinators Inc., www.thecoordinatorsinc.com

Conference Advisor

Lawrence Duffy, Executive Secretary, Arctic Division, AAAS, www.arctic.aaas.org

Publications

Annie Duffy, Duffy Infodesign, www.duffyinfodesign.com

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Area 3 Representative (Yukon, Northwest Territories, and Nunavut)

Paul Driscoll, Yukon College

• *Conference Program* •

General Information

Registration Desk

The AAAS registration staff will provide assistance with program information, audio and visual aids for sessions, and other administrative needs. The registration desk will be open:

Monday, Oct. 2nd at the Westmark's Gold Ballroom Entry from 8:00 a.m. to 5:00 p.m.
Tuesday, Oct. 3rd at the Westmark's Gold Ballroom Entry from 8:00 a.m. to 5:00 p.m.
Wednesday, Oct. 4th at the Westmark's Gold Ballroom Entry from 8:00 a.m. to 5:00 p.m.

Conference Fees

Full Conference:	\$200
Single Day:	\$70
Student:	\$90
Student Single Day:	\$15

*All registrations include snacks on the days registered.

Badges

Each participant should obtain a badge at the registration desk prior to attending any of the sessions.

Snacks and Registration Room

Snacks will be available in the in the registration room.

List of Participants

A list of pre-registered conference participants will be available at registration.

Poster Sessions

Posters will be on display according to the following schedule:

Monday, Oct. 2nd from 9 a.m. to 5 p.m.
Tuesday, Oct. 3rd from 9 a.m. to 5 p.m.
Wednesday, Oct. 4th from 9 a.m. to 5 p.m.

Authors will be present to discuss their material at 4 p.m. each day or they will designate times when they will be available for questions.

Lunch

The conference has scheduled a one and a half hour lunch break on each day.

Shuttle Schedule

On Oct. 2nd, 2006 at 5:30 p.m. shuttle service providing transportation between the Westmark and the UA Museum of the North will begin and continue till 9:30 p.m.

Monday, October 2nd, 2006

8:00 a.m.

9:00 a.m. – 12:00 p.m.

Registration and Coffee Service Begins Plenary Session

Welcoming and Opening Remarks

John Walsh, AAAS President

Lawrence Duffy, AAAS Executive Secretary

Plenary Speakers

Larry Mercurieff, Alaska Native Science Commission and Inuit Circumpolar Council

"Snowchange – Stories for the Raven: An International Workshop on Indigenous Observations of Ecological and Climate Change"

David Carlson, IPY Programme Office, British Antarctic Survey

"IPY as a Positive Factor in Long-Term Arctic Research"

James Overland, NOAA/Pacific Marine Environmental Laboratory

"State of the Arctic Report"

Carla Browning, UAF

"IPY and the Media"

Welcome by Chancellor Steve Jones, UAF

12:00 p.m. – 1:30 p.m.

1:30 p.m. – 3:30 p.m.

1:30 p.m. – 4:00 p.m.

Lunch Poster Set Up Technical Sessions:

West Gold Room

Terrestrial Ecosystems in a Changing Arctic, Part I

Andrea Lloyd, Dept. of Biology, Middlebury College

Middle Gold Room

Art and Science: Inspiration and Collaboration

Annie Duffy, Artist and POLARities Exhibition Curator

East Gold Room

International, Interdisciplinary and Collaboration

Karen Erickson, Dept. of Political Science, UAF

Ice and Snow

John Walsh, International Arctic Research Center, UAF

3:30 p.m. – 5:00 p.m.

6:00 p.m. – 9:00 p.m.

Poster Session with Refreshments Reception (UA Museum of the North)

Tuesday, October 3rd, 2006

8:00 a.m.

9:00 a.m. – 5:00 p.m.

9:00 a.m. – 12:00 p.m.

Registration and Coffee Service Begins Poster Displays Technical Sessions:

West Gold Room

Managing Resources for Resilience in Conditions of Rapid Change

Gary Kofinas, SNRAS and IAB, UAF

Middle Gold Room

Socioeconomic Issues in the Arctic

Fran Ulmer, Institute of Social and Economic Research, UAA

East Room

Persistence of Climate Change in Northern High-Latitudes

James Overland, NOAA/Pacific Marine Environmental Laboratory

12:00 p.m. – 1:30 p.m.
1:30 p.m. – 4:00 p.m.

Lunch
Technical Sessions:

West Gold Room

Africa and Alaska: Similarities and Differences in Human Dimensions.
Henry Huntington, Huntington Consulting

Middle Gold Room

High-Latitude Marine Ecology
Clara Deal, International Arctic Research Center, UAF

East Gold Room

Terrestrial Ecosystems in a Changing Arctic, Part II
Andrea Lloyd, Dept. of Biology, Middlebury College

4:00 p.m. – 5:00 p.m.
5:00 p.m. – 7:00 p.m.
7:00 p.m. – 8:30 p.m.

Poster Sessions with Refreshments
Dinner Break
Arctic Institute of North America, Thirteenth Arctic Forum:
Changing Marine Access in the Arctic (Panel) and Carl Benson, AINA

Wednesday, October 4th, 2006

8:00 a.m.
9:00 a.m. – 12:00 p.m.

Registration and Coffee Service Begins
Technical Sessions:

West Gold Room

International Polar Year
Martin Jeffries, Geophysical Institute, UAF

Middle Gold Room

The Contribution of Human Dimensions Research to Observing and Understanding
Maribeth S. Murray, Director HARC Core Office, Dept. of Anthropology, UAF

East Gold Room

Go North! Education and Research through Adventure Learning
Henry Huntington, Huntington Consulting

1:00 p.m. – 1:30 p.m.
1:30 p.m. – 4:15 p.m.

AAAS Business Meeting
Technical Sessions:

West Gold Room

Panel: Community-based Monitoring
Martin Jeffries, Geophysical Institute, UAF and Hajo Eicken Dept. of Geology
and Geophysics, UAF

Middle Gold Room

Circumpolar Health and Education
Lawrence Duffy, Director SNRP, UAF

East Gold Room

EPSCoR
Dorothea Moss, EPSCoR, UAF

4:15 p.m. – 4:30 p.m.

Closing Session

• AAAS Arctic Division Meeting History •

The Arctic Division of the American Association for the Advancement of Science (AAAS) has a long and illustrious history. Founded in 1951 as the Alaska Division, the Arctic Division was established to foster scientific communication in the then rather isolated Arctic territory. The name was changed to Arctic Division in 1982 to reflect the membership's growing interest in high latitudes outside of Alaska. Most of the Division members reside in Alaska and Canada's Yukon, Northwest Territory, and Nunavut, but any AAAS member who has an interest in the Arctic may join. More information about the AAAS Arctic Division can be found online at www.arctic.aaas.org.

Previous AAAS Arctic Division Meetings

No.	Dates	Year	Location	Chair	Theme
1	Nov. 9 - 11	1950	Washington, D.C.	John C. Reed	Science in Alaska
2	Sept. 4 - 8	1951	Mt. McKinley National Park	Laurence Irving, UA Biology Dept.	Science in Alaska
3	Sept. 22 - 27	1952	Mt. McKinley National Park	Laurence Irving, UA Biology Dept.	Science in Alaska
4	Sept. 28 - Oct. 3	1953	Juneau	Christian T. Elvey, UA Geophysical Inst.	Science in Alaska
5	Sept. 7 - 10	1954	Anchorage	Hugh A. Johnson, US Dept. of Agriculture	Science in Alaska
6	Jun. 1 - 4	1955	College	Neil W. Hosley, Univ. of Alaska	Science in Alaska
7	Sept. 27 - 30	1956	Juneau	Troy L. Pewe, US Geological Survey	Science in Alaska
8	Sept. 10 - 13	1957	Anchorage	Victor P. Hessler, Univ. of Alaska	Science in Alaska
9	Sept. 2 - 5	1958	College	Robert L. Rausch, Arctic Health Res. Cntr.	Science in Alaska
10	Aug. 25 - 28	1959	Juneau	Norman J. Wilimovsky, Fisheries	Science in Alaska
11	Aug. 30 - Sept. 2	1960	Anchorage	Roger R. Robinson, US Bureau Land Mgmt.	Science in Alaska
12	Aug. 28 - Sept. 1	1961	College	John P. Hannon, Arctic Aeromedical Lab	Science in Alaska
13	Aug. 22 - 26	1962	Juneau	James W. Brooks, AK Dept. of Fish & Game	Science in Alaska
14	Aug. 22 - 30	1963	Anchorage	Allan H. Mick, AK Agricultural Exp. Sta.	Science in Alaska
15	Aug. 31 - Sept. 4	1964	College	Charles J. Eagan, Arctic Aeromedical Lab	Science in Alaska
16	Aug. 30 - Sept. 1	1965	Juneau	Richard M. Hurd, Inst. Northern Forestry	Science in Alaska
17	Aug. 29 - Sept. 2	1966	Anchorage	William Davis, Alaska Methodist Univ.	Science in Alaska
18	Aug. 28 - Sept. 1	1967	College	Peter R. Morrison, UA Inst. of Arctic Biology	Science in Alaska
19	Aug. 26 - 30	1968	Whitehorse	Richard Hill, Dept. of Indian Affairs	Science in Alaska & Northern Development
20	Aug. 24 - 27	1969	College	Victor Fisher, UA Inst. Social & Econ. Res.	Change in the North: People, Petroleum & Environment
21	Aug. 16 - 19	1970	College	T. Neil Davis, Geophysical Inst.	Change in the North: UA Physical Environment
22	Aug. 17 - 19	1971	College	Laurence Irving, UA Inst. Arctic Biology	Adaptation for Northern Life
23	Aug. 15 - 17	1972	Fairbanks	Gordon S. Harrison, UA Inst. Social & Econ. Res.	Science and Policy in the North
24	Aug. 15 - 17	1973	Fairbanks	Gunter E. Weller, UA Geophysical Inst.	Climate of the Arctic
25	Oct. 18 - 20	1974	Anchorage	William Davis, Alaska Methodist Univ.	Behavioral Sciences in the North
26	Aug. 11 - 15	1975	Fairbanks*	Donal W. Hood, UAF Inst. Marine Science	Third International Conference on Port & Ocean Engineering Under Arctic Conditions (POAC)
27	Aug. 4 - 7	1976	Fairbanks	George C. West, UAF Inst. Arctic Biology	Resource Development: Processes and Problems
28	Sept. 22 - 24	1977	Anchorage	David M. Hickok, UM Arctic Environ. Info. & Data Center	Science Information Exchange in Alaska

No.	Dates	Year	Location	Chair	Theme
29	Aug. 15 - 17	1978	Fairbanks	Donald H. Rosenberg, UA Alaska Sea Grant	Alaska Fisheries: 200 Years & 200 Miles of Change
30	Sept. 19 - 21	1979	Fairbanks	Daniel B. Hawkins, UAF Geophysical Inst.	Science for Alaska
31	Sept. 17 - 19	1980	Anchorage	E. Lee Gorsuch, UAA Inst. Social & Econ. Res.	Agenda 80S
32	Aug. 25 - 27	1981	Fairbanks	John Bligh, UAF Inst. Arctic Biology	Life Sciences in the Service of Alaska
33	Sept. 16 - 18	1982	Fairbanks	Vera Alexander, UAF Inst. Marine Science.	Science in the North
34	Sept. 28 - Oct. 1	1983	Whitehorse	Arthur Pearson, Rampart Dev. Corp.	Alaska/Canada North: Neighbours in Science
35	Oct. 2 - 5	1984	Anchorage	John Davies, UAF Geophysical Inst.	Science in Public Policy
36	Sept. 27 - 29	1985	Fairbanks	Robert G. White, UAF Inst. Arctic Biology	Technology and the Scientist
37	Jun. 8 - 13	1986	Vancouver**	Richard Bushey, Yellowknife, NWT	All Disciplines
38	Sept. 24 - 26	1987	Anchorage	Thomas Morehouse, UA Inst. Social & Econ. Res.	Alaska's Resources, Alaska's Future
39	Oct. 7 - 10	1988	Fairbanks	Neal B. Brown, UAF Geophysical Inst.	Science Education
40	Sept. 14 - 16	1989	Fairbanks	Francis Williamson, UAF Inst. of Arctic Biology	Global Change
41	Oct. 8 - 10	1990	Anchorage	Thomas Newbury, US Minerals Mgmt. Serv.	Circumpolar Perspectives
42	May 16 - 18	1991	Fairbanks***	Neal B. Brown, UAF Geophysical Inst.	Circumpolar Modeling of Climate Change
43	Sept. 8 - 12	1992	Valdez	Kenneson Dean, UAF Geophysical Inst.	Environmental Change: Natural and Man-Made
44	Sept. 15 - 18	1993	Whitehorse	Arthur Pearson, Rampart Dev. Corp.	Circumpolar Information Exchange: Shrinking the Circumpolar Community
45	Aug. 25 - 27 Aug. 29 - Sept. 2	1994	Anchorage Vladivostok	Rosa Meehan, US Fish & Wildlife Serv.	Bridges of Science Between North America and the Russia Far East
46	Sept. 19 - 21	1995	Fairbanks	Robert G. White, UAF Inst. of Arctic Biology	Landscapes
47	Sept. 19 - 21	1996	Girdwood	Jack Kruse, UA Inst. Social & Econ. Res.	Shaping an Unpredictable Future: Science and Communities
48	Sept. 24 - 27	1997	Valdez	R. Ted Cooney, UAF Inst. Marine Science	Arctic Science and Resource Management: Exploring the Issues
49	Oct. 25 - 28	1998	Fairbanks	Syun-ichi Akasofu, UAF Geophysical Inst.	International Cooperation in Arctic Research: Detecting Global Change and its Impacts in the Western Arctic
50	Sept. 19 - 22	1999	Denali National Park & Reserve	Claus-M. Naske, UAF History Dept.	Science in the North: 50 Years of Change
51	Sept. 21 - 24	2000	Whitehorse	Joan Eamer, Yukon Science Inst.	Science and Community Crossing Borders - Arctic Science 2000
52	Sept. 12 - 15	2001	Anchorage****	Don Spalinger, AK Dept. of Fish & Game	2001 Arctic Science Odyssey: Exploring New Technologies and Methodologies for Arctic Science Management
53	Sept. 18 - 21	2002	Fairbanks	Terry Whitledge, UAF Inst. Marine Science	Connectivity in Northern Water: Arctic Ocean, Bering Sea, and Gulf of Alaska Interrelationship
54	Sept. 21 - 24	2003	Fairbanks	John C. Eichelberger, UAF Geophysical Inst.	Extreme Events: Understanding Perturbations to the Physical and Biological Environment
55	Sept. 14 - 16 Sept. 26 - Oct. 1	2004	Vladivostok - 1 Anchorage - 2	Craig E. Dorman, VP Research UA Statewide System	1 - Bridges of Science 2 - Human Dimensions of the Arctic Environment
56	Sept. 27 - 29	2005	Kodiak	Scott Smiley, Fishery Industrial Technology Center, UAF	Consequences of Arctic and Sub-Arctic Environmental Variation

*Arctic Division co-sponsored the International Port and Ocean Engineering Under Arctic Conditions (POAC) Conference

**Joint with the Pacific Division

***Yukon College cancelled; conference moved to Fairbanks

****Not held due to the tragic events of Sept. 11, 2001 at the World Trade Center and the Pentagon

2006 Arctic Science Conference Abstracts

Abstracts are listed alphabetically according to first author.

1. Understanding the Conflict Dimensions in the Savannah Belt, Sudan: Path to Sustainable Peace in the Post-war Period

Mey Ahmed

This paper explores the socioeconomic and natural factors of the environmental conflict in Savannah Belt Africa. This region has been affected several times by conflict and environmental disasters (famine and drought), and this led to vulnerability to the climate changes and insecurity in socioeconomic, political and environmental arenas.

The local management systems were marginalized and banned, when new agricultural policies and property rights were applied in the 1970s to three areas examined in this study, the Blue Nile, Nuba Mountains, and Darfur. Three images of the environmental crises in Savannah Belt, Sudan, illustrate the mismanagement of natural resources as well as improper socioeconomic and environmental policies, resulting the prolonged crises and environmental changes. These areas are located in one climatic zone and affected differently by disputes in the time period under consideration. The paper highlights the cause and impact of the conflicts, how they escalated variously and similarly. Furthermore, the paper focuses on two approaches of the local and national systems in managing natural resources use, property rights and conflict mitigation, how national and local interacted negatively and failed to manage the natural resources, leading to environmental disputes and changes in the region. The recommendations and conclusions reflect proper solutions and urgent reforms to the comprehensive peace agreement (CPA, signed in 2005) in the post-conflict times. An appropriate management system is not only the magical key for sustainable natural resources use and ownership, but also for the economic development, political stability, environmental conservation, social welfare and security.

2. Industries, Traditions and Freshwater Resources: How Land Use Affects Local Resilience

L Na'ia Alessa, Andrew Kliskey, Michael Barton

EPSCoR Poster

3. The Modulation of Metabolism by Hydrogen Sulfide (H₂S)

Kelsey Alexander, Barbara Taylor, Michael Harris

H₂S has been shown to induce a reversible, suspended animation-like state in a nonhibernating species of mouse. To investigate the poorly understood cellular mechanisms of H₂S-induced metabolic suppression, we are using cellular respirometry. This technique allows us to monitor cellular metabolism via the oxygen consumption of isolated hepatocytes. We tested the hypotheses that an exogenous source of H₂S and an altered endogenous H₂S synthesis will alter cellular metabolism. We tested the influence of H₂S produced from NaHS (10 mM) and have identified that 10 mM NaHS produces an approximately 20% decrease in cellular oxygen consumption for about 30 minutes, whereas doses higher than 10 mM are toxic to the cell culture. These data indicate that cellular metabolism can be modulated by exogenous H₂S application. L-cyano-L-alanine (BCA), an inhibitor of the H₂S-producing enzyme Cystathione-lyase (CSE), reduces oxygen consumption by approximately 30% for periods exceeding one hour at a concentration of 10 mM. After one hour, a 1 mM dose of BCA will begin to decrease oxygen consumption. Due to the several different metabolic pathways involved in H₂S synthesis, blocking CSE may have lead to an increase in endogenous H₂S via several other metabolic pathways. The slower action of the 1 mM BCA dose may be caused by a slower increase in H₂S production, since only a few CSE mediated H₂S synthesis pathways were blocked. These results suggest that both endogenous and exogenous H₂S inhibits metabolism at low doses.

This research is supported by an Undergraduate Student Project Award from Alaska INBRE.

4. The Influences of Global Change on Rural Alaska: The Role of Place-Appropriate Science Education in Facilitating Adaptation

Jodie Anderson, Todd Radenbaugh, Greg Finstad

The socio-economic and ecological environments of many Rural Alaskan communities are changing at a rapid pace. To maintain healthy communities, awareness of and adaptation to these changes are vital. To be successful, communities must promote the development of educational infrastructure that not only identify trends of change, but also integrates change compatible with local cultural practices. For example, can wild salmon stocks, in the case of Southwest Alaska and reindeer on the Seward Peninsula still be major economic factors given the rapid pace of climate and economic change? One important avenue for adaptation is to develop the educational infrastructure through the rural higher education system. The rural university system is regionally based so it has the familiarity with local communities to develop and implement a culturally relevant adaptation strategy.

To promote community adaptation to rapid outside change, the Bristol Bay and the Northwest Campuses of the University of Alaska Fairbanks have developed two place-appropriate, science-based certificate programs: environmental science and high latitude range management, respectively. These programs are designed to help rural communities adapt to external drivers to maintain sustainable economies and cultures. Two important agents of change in Rural Alaska are increased interests in resource extraction (petroleum and mineral resources) and climate change. Both of these have the potential to significantly alter ecosystem dynamics and traditional social institutions.

Therefore, is it critical that the regional university system work cooperatively with decision makers, industry and residents in full cost accounting, which investigates potential ecosystem changes in terms of natural, human, social, and manufactured capital. With a goal to provide the education and training that will empower residents to participate in the decision making process, the University of Alaska Fairbanks' rural campuses are positioned to build resilience through higher education. These programs show that rural universities can develop the necessary infrastructure to allow rural communities to voice their concerns and deal adaptively with their rapidly changing ecosystems.

5. Moose Browsing Effects on White Spruce (*Picea glauca*) Seedling Growth on the Tanana River Floodplain: Changes in Microhabitat and Cover

Amy Angell, Knut Kielland

The Tanana River floodplain is one of the most productive regions of boreal forest in interior Alaska. Primary floodplain succession is marked by the colonization of silt bars by willows, typically *Salix interior* and *Salix alaxensis*, which are favored browse species for moose (*Alces alces*). On these terraces, moose often browse *S. interior* down to the snow cover creating "browsing lawns" during the winter months. This study is focused on determining how moose browsing alters the microclimate, plant canopy, and soil chemistry for later successional species, particularly white spruce (*Picea glauca*). We hypothesized that moose browsing will alter the microhabitat by opening the plant canopy leading to increases in radiation (PAR), temperature, and salt crust formation. To test these hypotheses, spruce seedling growth, canopy change of shrub vegetation, and microclimate parameters were measured in and out of 12 moose-proof exclosures. The exclosures (established 2003) are located along a terrace-height gradient on the Tanana River. Cover analysis of vegetation was performed using the line-intercept method to determine the shrub canopy composition over the seedlings. Across the terrace gradient, moose browsing had a negative effect on the canopy cover over the seedlings. Moreover, mean needle angle of spruce seedlings also increased inside the exclosures and along the terrace gradient suggesting an increased competition for light with increased total vegetation cover. Although white spruce is a slow growing species, yearly height measurements and survivorship have varied across the exclosures with older sites exhibiting increased vigor and higher survivorship rates than young terraces. These data show how large herbivores, like moose, may control successional dynamics through vegetation removal changing the local habitat causing a delay in the natural establishment of late succession white spruce trees.

6. POLARities Exhibit Artist Presentation

Miho Aoki

Science and Art both invite observation of the world around us and challenge us to deepen our understanding of these complex subjects. Both fields require intuition, creativity and exploration of the process. As scientists and artists, we propose our views of the subject and share it with others through creative or

scientific processes. The artist discusses the creative process of her art works in POLARities, Art and Science exhibition.

7. Nutrient Limitations Constrain the Feedback Capacity of Landscapes in the High Arctic

Seth Arens, Paddy Sullivan, Jeffrey Welker, Matthew Rogers

Nutrient availability appears to be a controlling factor in the structure and function of High Arctic terrestrial systems as depicted by biological hot spots such as bird cliffs which are found throughout the Arctic. Understanding the processes by which nutrients control plant production, canopy structure, and ecosystem carbon cycling have been well studied in the Low Arctic, where fertilization experiments have been employed for decades. However, few studies have examined how nutrient augmentations (fertilization) affect the magnitudes and patterns of CO₂ exchange, species composition and the optical properties of prostrate high arctic dwarf-shrub, herb tundra, the largest ecosystem in the High Arctic. In this study, factorial amendments of nitrogen (N) and phosphorus (P) were initiated in high arctic prostrate dwarf-shrub, herb tundra near Pituffik (Thule), Greenland (76°N, 68°W). Species composition, net ecosystem CO₂ exchange (NEE), gross primary photosynthesis (GPP), ecosystem respiration (ER) and plot-level normalized difference vegetation index (NDVI) were used to quantify changes in ecosystem structure and function. Strong and synergistic responses to the combined addition of nitrogen and phosphorus were observed. Increases in vegetation density and a shift in species composition were observed when N and P were added to these systems, partially explaining the near doubling of NDVI values from 0.3 to 0.6. These changes in vegetation density, plant cover and species composition occurred rapidly within two years of nutrient additions. Rates of NEE, GPP and ER were significantly higher when N and P were combined compared to independent additions of each or to non-fertilized areas. Combined N and P fertilization shifted the ecosystem from a small net source of CO₂ to a small net sink of CO₂ during the growing season. With consideration to both species composition and NDVI properties, fertilization of prostrate dwarf-shrub, herb tundra caused a shift towards a bird-cliff type plant community present in isolated patches throughout northwest Greenland. Our results indicate that feedback processes such as CO₂ exchange, optical properties and vegetation composition and structure are co-limited by N and P. The rapidity by which these dramatic changes occurred indicates that increases in atmospheric N deposition or the stimulation of organic matter decomposition and the mineralization of N due to warmer air and soil temperatures has the capacity to completely alter surface dynamics and feedback processes in the High Arctic.

8. Improving Coastal Zone Emergency Response: A pathway from Research to Human Benefits

David Atkinson, John Marra, Oceania Francis-Chythlook, James Partain, David Levinson, John Jensen

An important application of improved coastal zone understanding and management is the mitigation of risk. The Arctic coastal zones are the loci of extensive human community, subsistence, and infrastructure activity as well as sensitive natural ecosystems. Research efforts to describe and categorize the coastal state, combined with work to understand relevant natural processes, improve general understanding of the coastal situation and have reached high levels of completion for many regions of the circum-arctic (e.g. Rachold et al. 2005). While these new levels of coastal system understanding can serve as springboards, when combined with information about external forcing agents (e.g. as provided by national weather agencies), to launch highly specific efforts to reduce potential loss from damaging events, many research results remain unavailable to those who could best employ them.

We describe several efforts recently initiated by the US National Oceanic and Atmospheric Administration (NOAA), in partnership with University of Alaska Fairbanks and University of Hawaii, that are leading to operational products better tailored to emergency planning and response for coastal zones in both the Alaskan arctic and in selected Pacific coastal regions (Hawaii and Alaska). These projects are bringing together coastal experts from a wide array of US federal and Alaskan state agencies, academia, non-affiliated research groups, and private consulting firms to identify existing capacity, gaps, and requirements to enable NOAA to build operational capacity and assist emergency management decision-making in the three time frames identified above. To reach this objective the project must first identify gaps and capacities in the following areas: data (climate/oceanic), wave modeling, geodesic information (high-resolution bathymetry, topography, coastal composition), and infrastructure database/cataloguing. Ongoing aspects of the project will utilize what is available, forging alliances where necessary, or else try to build necessary capacity where it does not already exist.

9. The Common Raven through the Eyes of Oil Field Workers: Local Knowledge in Alaska's North Slope Oil Fields

Stacia Backensto, Gary Kofinas, Abby Powell, Craig Gerlach, Erich Follmann

Local knowledge is an intimate understanding of one's landscape, its inhabitants, and patterns of change that occur over time. Most of today's treatment of local knowledge in the North is focused on Indigenous Peoples. Western science is increasingly recognizing the value of local knowledge and its contribution to understanding the 'big picture' of ecosystems, essential for sustainable management. In this study we focus on the industrial landscape of Alaska's North Slope oil fields, characterized by a large community of oil field workers, many of whom have worked there for more than 20 years. We interviewed and surveyed oil workers in 2005 and 2006 at BP Exploration Alaska Inc. and ConocoPhillips Alaska Inc. leased facilities to document their knowledge of the common raven (*Corvus corax*). This work is part of a larger research effort focused on raven ecology and use of anthropogenic resources in the oil fields. Local knowledge research was structured through modified focus groups, individual interviews, and short questionnaires. Information yielded from these methods provided historical perspective on raven abundance and distribution. Participants described spatial and temporal variation in raven activities and provided detailed descriptions of infrastructure use. These observations aided us in formulating hypotheses to investigate nest site selection in response to human activities and infrastructure. Furthermore, we documented worker perspectives describing the social context of interactions between workers and ravens. The knowledge of this industrial-arctic environment demonstrated by interviewees suggests the value of ecological monitoring by oil field workers.

10. The Role of Historical Fire Disturbance in the Carbon Dynamics of the Pan-Boreal Region: A Process-Based Analysis

Michael Balshi, A. David McGuire

Wildfire is a common occurrence in ecosystems in northern high latitudes (the pan-boreal region), and changes in the fire regime in this region have consequences for carbon feedbacks to the climate system. To improve our understanding of how wildfire influences carbon dynamics of the pan-boreal region, we (1) developed methods to evaluate the effects of fire on carbon storage in the region, (2) estimated fire emissions and changes in carbon storage in the region, and (3) evaluated the role of historically recorded fire in the carbon dynamics of the region in the context of ecosystem responses to changes in atmospheric CO₂ concentration and climate. To evaluate the temporal and spatial changes of carbon dynamics in response to changes in CO₂, climate, and fire disturbance, we developed a fire module for the Terrestrial Ecosystem Model (TEM) and simulated carbon dynamics for the pan-boreal region north of 45° N from year 1000 through year 2002. We analyzed results for the periods of historically recorded fire disturbance, which were 1959 – 2002 in boreal North America and 1996 – 2002 in the pan-boreal region. Average annual emissions from wildfires for the period 1959-2002 for boreal North America averaged 40.0 Tg C yr⁻¹. Average annual emissions across North America, Eurasia, and the pan-boreal region for the period 1996-2002 were 46.8 Tg C yr⁻¹, 334.2 Tg C yr⁻¹, and 381.0 Tg C yr⁻¹, respectively. Simulation results for North America indicate that from 1959-2002, the combination of variability in atmospheric CO₂, climate, and fire were responsible for sequestering 81.7 Tg C yr⁻¹ (7.5 g C m⁻² yr⁻¹). The isolation of individual effects for North America from 1959-2002 identified that atmospheric CO₂ was responsible for sequestering 50.4 Tg C yr⁻¹ (4.0 g C m⁻² yr⁻¹), climatic variation was responsible for sequestering 46.9 Tg C yr⁻¹ (3.7 g C m⁻² yr⁻¹), and fire was responsible for releasing 15.6 Tg C yr⁻¹ (1.2 g C m⁻² yr⁻¹). Simulation results for the pan-boreal region for the time period from 1996 and 2002 indicate that carbon storage increased in response to changes in CO₂, climate, and fire disturbance by 375.2 Tg C yr⁻¹. The isolation of individual effects identified that atmospheric CO₂ fertilization was responsible for sequestering 284 Tg C yr⁻¹ (9.9 g C m⁻² yr⁻¹), climate variability was responsible for sequestering 136.9 Tg C yr⁻¹ (3.6 g C m⁻² yr⁻¹), and fire was responsible for releasing 46.3 Tg C yr⁻¹ (1.2 g C m⁻² yr⁻¹). Although our analysis suggests that CO₂, climate, and fire each play important roles in carbon dynamics across the pan-boreal region, there are substantial uncertainties in each of the effects. It is important to reduce these uncertainties to better predict how fire will influence carbon storage of this region in the future.

11. Arctic Geobotanical Atlas

E.M. Barbour, H.A. Maier, Donald Walker, J.P. Grimes, A.W. Balzer

The Arctic Geobotanical Atlas (AGA) is a web-based multi-scale (plant-to-planet) collection of geobotanical maps and supporting data. Vegetation is mapped at eight scales ranging from 1:1 scale (1-m plots) to 1:7,500,00 (entire Arctic). Visualization tools allow users to view thematic maps and raster data by several methods. The AGA currently focuses

on the Circumpolar Arctic, Arctic Alaska, the upper Kuparuk River Region, Alaska, and the Arctic Long-Term Ecological Research site at Toolik Lake, Alaska. Diverse geobotanical themes include vegetation, geology, topography, landforms, surficial geomorphology and soil type. Vegetation data is linked to the primary literature, providing detailed community and species descriptions. The maps and web site were developed at the Alaska Geobotany Center in collaboration with several other groups at the University of Alaska Fairbanks, including: Water and Environmental Research Center (WERC, <http://www.uaf.edu/water/>), Geographic Information Network of Alaska (GINA, <http://www.gina.alaska.edu/>), and Toolik Field Station (TFS, <http://www.uaf.edu/toolik/>).

The AGA will also be one of the primary outreach and education components for the upcoming Greening of the Arctic (GOA) project (a component of the International Polar Year initiative). The GOA project will examine the spatial and temporal trends of greening in the Arctic, how these trends are affecting the indigenous people of the Arctic, and communicate the results of the study to students, scientists, government agencies, and the general public. A variety of tools will help students, educators, scientists, land managers and the general public to understand issues related to the greening of the Arctic. Users will be able to access data (GIS, environmental measurements) and descriptive information (reports, prepared maps, refereed publications), from the Circumpolar Arctic Vegetation Map and other maps at several sites along the GOA transects.

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12. Fish By-Products Processing In Alaska

Peter Bechtel, Cynthia Bower, Charles Crapo

Over 50% of the total wild fish harvested and processed for human consumption in the USA come from Alaska waters. The world's largest fishery for human food is the Alaska pollock fishery and in addition large amounts of salmon, cod and flat fish are harvested. Fish processing create by-products which can be utilized for a number of products; however, there is scant information on the amounts and types of the seafood processing by-products produced in Alaska. The objective of this analysis was to estimate the amount of fish processing by-products generated in Alaska waters as a function of 1) species, 2) amount of individual waste components (heads, viscera, frames, skin), 3) region, and 4) processing sector.

Data used in this analysis was obtained from the National Marine Fisheries Service 2005 harvest statistics for ground fish, and the Alaska Department of Fish and Game 2005 harvest statistics for salmon and herring, and contacts with industry personnel. Amounts of heads, frames, viscera, skin and fillets were calculated from published values for fish part composition. Results indicated that in 2005 the Alaska marine fin fish harvest was approximately 2,450,000 metric tons (MT) and after processing an estimated 1,300,000 MT of fish by-products remained. The major by-product constituents were heads, viscera, frames and skins. Fish processing by-products from pollock and cod accounted for 79% of the total fish by-products produced. FY 2005 estimates of fish meal and oil production in Alaska were over 100,000 MT. A lot of Alaska seafood processing by-products remain underutilized, which translates into opportunity to produce oils, meals and other products from individual waste stream components such as heads, viscera, frames and skins or combinations of these components. Results from the 2005 estimates will be contrasted with results from the year 2000 and by-product utilization discussed.

13. Which Species Hybridized to Form the Allopolyploid *Arabidopsis Lyrata* Subspecies *Kamchatica*?

Jessica Beecher, Janette Steets, Diana Wolf

Polyploidy, the presence of more than one genome per cell, has played a major role in the speciation of flowering plants. A polyploid can be classified as autopolyploid or allopolyploid, depending on whether the diploid parents are from the same species or from two separate species. *Arabidopsis lyrata* throughout most of its range is a diploid, but flow cytometry data indicate *A. lyrata* subsp. *kamchatica* is a tetraploid throughout its range. The goal of this project was to determine the origin of the tetraploid species *A. l.* subsp. *kamchatica*. Specifically, the goals were to determine whether *A. lyrata* is allopolyploid or autopolyploid and, if possible, to determine the parentage of *A. l.* subsp. *kamchatica*. This was achieved by comparing the DNA sequences for the CHI gene from diploid from European and North American *A. lyrata* with Alaskan, Japanese, and Russian populations of *A. l.* subsp. *kamchatica*. Nine populations of *A. l.* subsp. *kamchatica* were sequenced for the CHI gene (4 Alaskan, 3 Japanese and 2 Russian). These sequences

were compared with sequences downloaded from GENBank for *A. l.* subsp. *petraea* and *A. halleri* subsp. *halleri*. Our data indicate *A. l.* subsp. *kamchatica* is an allopolyploid with diploid *A. l.* subsp. *petraea* and one of the subspecies of *A. halleri* as the likely ancestral hybridizing species. Future projects will include sequencing *A. l.* subsp. *lyrata* and *A. halleri* subsp. *gemmifera* for the CHI gene.

14. Climatic Determinants of Widespread Yellow-Cedar Decline in Temperate Rainforests of Southeastern Alaska

Colin Beier, Scott Sink, Glenn Juday, Dave D'Amore, Paul Hennon

Decline of yellow cedar (*Chamaecyparis nootkatensis*) has affected nearly 200,000 hectares of coastal mixed-conifer temperate rainforest in southeastern Alaska, making it the most extensive non-anthropogenic forest decline known in North America. Cedar dieback occurs primarily at the low elevation ecotone in populations that established during the Little Ice Age, a period of cooling that ended circa 1880. Based on regionally extensive tree-ring chronologies, we analyzed the 20th century growth responses of yellow-cedar populations to regional climatic variation. Our findings suggest that climatic change is an ultimate factor in yellow-cedar decline. Warmer conditions (thaws) in late winter may both trigger dehardening in yellow-cedar and result in reduced snowpack that insulates exposed soils against freezing. We hypothesized this would make yellow-cedar more vulnerable to early-spring frosts that are common in southeastern Alaska. An increasing frequency of thaw-freeze events in the latter half of the 20th century corresponded with increased mortality of yellow-cedar. A severe thaw-freeze event during a low snowfall year in 1987 was reflected in the chronologies of declining cedar forests throughout the region. We propose that the decline phenomenon represents a climate-mediated 'correction' for population expansions that occurred at the low elevation ecotone during the Little Ice Age. This caused yellow cedar to retreat to its historically endemic high-elevation habitat where snow cover persists into the growing season. Our findings – in conjunction with stand-level observations of decline symptoms, mortality dynamics, soil microclimate and persistence of snow cover – support this hypothesis over a large spatial and temporal scale.

15. Polychaete Juveniles in Arctic Fast Ice Off Barrow, Alaska – An Example for Cryo-Benthic Coupling

Bodil Bluhm, Rolf Gradinger

Sea ice plays an important role in providing food and a seasonal habitat for autochthonous and allochthonous polar metazoans. This ongoing study focuses on the largely unknown role of near-shore Arctic sea ice in the life cycle of marine benthic invertebrates with a focus on polychaetes. During the first project year, five field trips were conducted to Barrow, Alaska from Dec 2005-Jun 2006. Chlorophyll concentrations were highest in the bottom 10 cm of the ice and peaked in March-April (25-80µg chl a l⁻¹) while water column chl remained one to two orders of magnitude lower than concentrations in sea ice bottom sections throughout the sampling season at all three sites. Polychaete abundances varied between season and site, but were always highest in the bottom 0-10 cm horizon (maximum 336 individuals l⁻¹), whereas abundance in the water column was very low. Preliminary analysis of stable carbon isotope ratios indicates that at least one species of polychaete larvae utilize ice algae for their nutrition.

16. Omega-3 Fatty Acids in Salmon Preserved by Native Alaskan Methods

Cynthia Bower, Charlene Malemute, Alexandra Oliveira

Traditional Native Alaskan diets included salmon as a major source of n-3 long-chain polyunsaturated fatty acids (PUFA). However, in the last 250 years, profound changes have influenced the people of interior Alaska. Departure from ancestral dietary practices has led to a rise in obesity and Type-2 diabetes in Native youth. Increased consumption of long-chain PUFA has been linked to reduced risk of Type-2 diabetes in overweight individuals. The objective of this study was to preserve salmon by five different Native Alaskan methods, and then evaluate the status of n-3 fatty acids in each sample so that science-based recommendations could be made concerning food preservation choices.

A survey was conducted to determine salmon consumption patterns and preservation techniques commonly used along the Yukon River of interior Alaska. Based on this information, salmon fillets (consumed by 100% of survey respondents) and heads (consumed by 95%) were chosen for study. The five most common preservation methods were identified as jarring (26%), smoking (22%), freezing (22%), pickling (13%), and salting (13%).

Coho salmon (*Oncorhynchus kisutch*) fillets and heads were preserved using these common methods, then stored for 90-days before testing for n-3 long-chain PUFA. Lipids were extracted with a solvent mixture of isopropyl alcohol and hexane, and stored at -80°C under a headspace of nitrogen. Fatty acids were converted to their methyl esters before being analyzed by gas chromatography. Moisture, ash, and protein values for each sample were also determined.

Total fatty acids for smoked and jarred fillets were higher than for salted, pickled, or frozen samples. The greatest quantity of n-3 PUFAs (82%) was retained when salmon fillets were either smoked or jarred. Other preservation methods were more destructive, with freezing, pickling, and salting retaining only 53%, 29%, and 24% (respectively) of the original n-3 PUFA content. Salmon heads contained over 300% more total fatty acids than fillets, as well as higher levels of n-3 PUFAs even after boiling.

17. Rheological Behavior of Ice-rich Syngenetic and Intermediate Layer Permafrost

Matthew Bray

Creep tests on ice rich permafrost from the CRREL Permafrost Tunnel have been conducted which show that cryogenic structure has a significant influence on the resulting creep behavior of permafrost soils. Permafrost soils with micro-lenticular cryogenic structure (water contents range from 80% to 150%) representing undisturbed Pleistocene syngenetic permafrost were uniaxially compressed under constant stress, constant strain rate, or relaxation conditions. Permafrost soils with massive cryogenic structure (water contents range from 50% to 70%) were also tested. Micro-lenticular soils showed greater creep behavior when the sample was loaded with the dominant ice lenses were perpendicular to the principle stress rather than parallel to the principle stress. Anisotropic creep was seen for micro-lenticular soil with ice lenses parallel to the principle stress which resulted in lateral strains perpendicular to the ice lenses being 2.6 to 3.2 times greater than parallel to the ice lenses. Permafrost soils with massive cryogenic structure tended to show increased creep behavior over the more ice-rich micro-lenticular permafrost samples. Relaxation tests at $-1.0 \pm 0.730^{\circ}\text{C}$ for vertically oriented micro-lenticular structure, suggest that the long term strength is less than 5 psi.

18. Seasonal Changes in the Diet of a Non-Hibernating High-Latitude Rodent: the Northern Red-Backed Vole, *Clethrionomys rutilus*

April Brennan, Ian Van Tets

Rodents, such as lemmings and voles, which do not use hibernation and torpor, must choose foods that will enable them to meet their high energetic needs. These needs, and the food available to meet them, are likely to change seasonally. The aim of this study was to test whether free-living northern red-backed voles, *Clethrionomys rutilus*, preferentially ate items that were high in digestible energy, and whether seasonal dietary changes correlated with changes in plant availability. We used stomach, cecum, and colon contents to assess diet and measured the gross energy content and availability of common plants found in our field sites. The voles diet included a large proportion of hypogeous fungi from late spring through late fall with an increasing proportion of woody dicotyledonous roots in November. These roots contain vesicular-arbuscular mycorrhizae and are only common in the winter diet when epigeous fungi were rare in the field site. During spring thaw (April and May), the proportion of moss and young grass shoots increased to 35% of the diet. The changes in stomach contents were positively correlated with the gross energy content of plants. Our data support the hypothesis that voles preferentially eat energy rich and digestible foods and that seasonal dietary changes are correlated with availability of plants. They also highlight the importance of fungi to this species.

19. The Arctic Marine Shipping Assessment of the Arctic Council

Lawson Brigham

The Arctic Marine Shipping Assessment (AMSA) is an ongoing initiative of the Arctic Council's working group PAME (Protection of the Arctic Marine Environment). Led by Canada, Finland and the United States, AMSA is a natural follow-on to the Arctic Climate Impact Assessment (ACIA) and the Arctic Marine Strategic Plan of the Council. AMSA will be inclusive and will involve a wide range of key stakeholders, many of whom are outside the Arctic Council including non-Arctic states. The Permanent Participants will have key roles in AMSA and Town Hall meetings will be held in selected Arctic communities to gain insights into the local issues regarding future Arctic marine uses. Also, regional concerns are critical to the AMSA process; thus, key national interests include Norway and Russia in the Barents Sea, Iceland, Greenland and the Faroe Islands (beyond the interests of the US and Canada). A scenario development process will be

conducted to identify the drivers so that levels of marine activity can be projected for 2020 and 2050. An ongoing data survey of the levels of marine activity for 2004 will provide the current baseline for AMSA. The current and future levels of Arctic marine activity will be evaluated in terms of their social, environmental and economic impacts.

20. POLARities Exhibit Artist Presentation

Bill Brody

Art, Technology and Science: We seek to illuminate the seeming polarities of art and science. Science deals with slicing and dicing the world in order to make sense of it. Validation in the world is required for science to proceed. The tools necessary for validation are technological; which is to say they are tools whose use has been socially transmitted. Art deals with putting things together in order to make sense of them. Artists' tools are likewise technological in nature in that their use, too, must be socially transmitted. There is a natural pairing of art and science on the fundamental level of putting together what has been taken apart. One key to this pairing is found in the requirement for social transmission of ideas. Art and artists can and should serve to transmit the ideas of science. Science should look to art for some of its questions. Consider that the best definition of the history of art is the history of what people have made.

21. Permafrost and the International Polar Year

Jerry Brown

EPSCoR Poster

22. POLARities Exhibit Artist Presentation

Kim Brown

Ego Sum Pulvis; Observation and investigation into dust - away from the way of the disconnected mind.

Kim Brown is interested in the process that goes into making, initiating dialogue and asking questions about social, biological, cultural systems. Art for her is not only the production of isolated objects; but provides living-idea systems that promote observation and communication.

23. Ventilatory Consequences of Acute and Chronic Exposure to Nicotine

Cord Brundage, Justin Buehner, Barbara Taylor

The ventilatory consequences of chronic and acute exposure to nicotine were tested in *Rana catesbeiana* tadpoles. During early development, tadpoles were treated with chronic nicotine exposure (CNE; 18 mg/L in their pond water). Lung ventilation under conditions of normocapnia/normoxia, hypercapnia and hypoxia were measured in vivo and compared between control and CNE animals. Both control and CNE tadpoles exhibited a low frequency of lung breathing during normocapnia/normoxia and this frequency increased during hypercapnia and hypoxia, although the increase was less for CNE animals. Neural correlates of ventilation were measured in vitro. Neuroventilatory gill and lung bursts were recorded from the facial and hypoglossal nerves at their exit from the brainstem. These recordings were made while the entire brainstem was superfused with normocapnic/normoxic, hypercapnic or hypoxic artificial cerebrospinal fluid (aCSF). Brainstems from CNE animals exhibited ataxic buccal neuroventilation and failed to respond to hypercapnia and hypoxia. Normocapnic/normoxic, hypercapnic or hypoxic superfusions with aCSF containing 18 mg/L nicotine on isolated brainstems from control animals constituted acute nicotine exposure (ANE). ANE did not affect gill- or lung-bursting during normoxia/normocapnia, but did suppress lung-bursting during hypercapnia and hypoxia. Thus, exposure to nicotine, whether chronic (over months of development) or acute (applied to the in vitro brainstem preparation), suppresses the increases in lung bursting that is typically seen under hypercapnic and hypoxic conditions.

24. Ontogeny of Central O₂ Chemoreception: Hypoxic Response in the Brainstem of Developing Bullfrogs

Justin Buehner, Cord Brundage, Barbara Taylor

Central O₂ chemoreception was assessed in brainstems from *Rana catesbeiana* tadpoles of varying developmental stages. Neuroventilatory gill and lung bursts were recorded from the facial and hypoglossal nerves at their exit from the brainstem. These recordings were made while the entire brainstem was superfused with normoxic or hypoxic artificial cerebrospinal fluid (aCSF). Superfusion of the brainstem with hypoxic aCSF elicited an increase in lung bursts for the first hour of hypoxic exposure, but had no consistent influence on gill bursts. The increases in lung bursts were most pronounced among late-stage tadpoles, but these increases occurred among brainstems isolated from tadpoles of all developmental stages. Thus, like the tadpole's central response to hypercapnia, the central hypoxic response manifests as an increase in the rate of lung bursting. Lung-burst frequency decreased with prolonged hypoxic exposure. Occasionally central apnea (cessation of lung and gill bursts) occurred in the third hour of hypoxic exposure. Most isolated brainstems regained neuroventilatory rhythm when normoxic/normocapnic superfusion resumed following three hours of hypoxia. The present study, therefore characterizes the tadpole central hypoxic response as an increase in lung-burst frequency followed by a ventilatory depression with prolonged exposure. These results also attest to the remarkable hypoxia tolerance of bullfrog tadpoles.

25. Permafrost Distributions on the Seward Peninsula, Alaska, Snapshots in Time

Robert Busey, Larry Hinzman

Permafrost extent has been estimated for three different time periods, the early twentieth century, the present time, and the end of the twenty-first century using an equivalent latitude / elevation model based upon climate, terrain and soil property data (Yoshikawa et al., 2002) and also a ground temperature model, TTOP, which estimates the temperature at the top of the permafrost table. The TTOP model has been used before to estimate Canadian permafrost distributions but it is applicable to other areas as well. This region of sub-Arctic Alaska is a proxy for a warmer Arctic due to the broad expanses of tussock tundra, invading shrubs and fragile permafrost with average temperatures just below freezing. The equivalent latitude model estimates solar insolation by combining elevation, slope, and aspect. The distribution also uses n-factors and air temperature defined using MicroMet (Liston and Elder, 2005). Source data for the distributed model varied depending on the time period of interest. Early twentieth century data is from Nome, present day data came from eleven meteorological stations across the Seward Peninsula from the National Weather Service, SNOTEL, RAWS, and our own stations and finally, the twenty-first century data set is the result of meshing outputs from several IPCC approved GCM models. Simulations of permafrost extent will enable us to compare the current distribution to that existing during past climates and to estimate the future state of permafrost on the Seward Peninsula. The broadest impacts of climate warming to the terrestrial arctic regions will result through consequent effects of changing permafrost structure and extent. As the climate differentially warms in summer and winter, the permafrost will become warmer, the active layer (the layer of soil above the permafrost that annually experiences freeze and thaw) will become thicker, the lower boundary of permafrost will become shallower and permafrost extent will decrease in area. These simple structural changes will affect every aspect of the surface water and energy balances. As permafrost extent decreases, there is more infiltration to groundwater. This has significant impacts on large and small scales. Projections of changes in permafrost are an essential prerequisite to accurate prediction of changes in hydrology, ecology, and surface energy balance.

26. ARCUS Internet Media Archive (IMA): A Resource for Outreach and Education

Tina Buxbaum, Wendy Warnick, B. Zeb Polly, Katie Breen

The ARCUS Internet Media Archive (IMA) is a collection of photos, graphics, videos, and presentations that are shared through the Internet. It provides the arctic research community with a centralized location where images and video pertaining to polar research can be browsed and retrieved for a variety of uses. The IMA currently contains almost 5,000 publicly accessible photos, along with 360 video files, 260 audio files, and approximately 8,000 additional resources that are being prepared for public access.

The contents of this archive are organized by file type, photographer's name, event, or by organization, with each photo or file accompanied by information on content, contributor source, and usage requirements. All the files are keyworded and all information, including file name and description, is completely searchable.

ARCUS plans to continue to improve and expand the IMA with a particular focus on providing graphics depicting key arctic research results and findings as well as edited video archives of relevant scientific community meetings. To submit files or for more information and to view the ARCUS Internet Media Archive, please go to: <http://media.arcus>.

org or email photo@arcus.org.

27. Challenges and Opportunities in the International Polar Year 2007 - 2008

David Carlson

The International Polar Year 2007 – 2008 offers unprecedented opportunities and challenges. At this point, IPY appears likely to exceed previous international science programmes in size and participation; it will certainly engage an unusually broad range of specialists from biological, physical and social sciences. IPY will also draw enormous public attention. With this scale, breadth and prominence come several challenges. How will IPY researchers build collective understanding starting from highly specialized tools and terminology and very different traditions of data sharing? Having justified attention and funding based on urgent problems, how will science adjust its cautious work habits and procedures to provide quicker and clearer answers? How do we combine messages of alarm with positive options for personal or collective action by listeners? How will people of the North, including indigenous people, become research leaders and partners rather than research subjects. What legacies, perhaps as momentous as world data centres and Antarctic treaties for peaceful cooperation, will come from this IPY, particularly for the Arctic? Worldwide enthusiasm for IPY builds from a pervasive sense that IPY represents a once-in-a-career opportunity for science to respond to these crucial challenges.

28. IPY as a Positive Factor in Long-Term Arctic Research

David Carlson

The International Polar Year 2007 – 2008 offers a unique opportunity to observe the Arctic environment with both breadth and intensity. However, two years of IPY observations and activities, no matter how extensive or well-constructed, will not satisfy the urgent need for sustained multi-decadal observation and monitoring of Arctic physical, biological and social systems. As it stimulates important and welcome public interest in the Arctic, IPY may distract attention from longer-term needs. IPY can help close existing gaps between science and society, and thereby build an informed and appreciative audience for immediate and continuing science of polar regions. Active scientific partnerships with Arctic communities, particularly through broadly defined and consultative community monitoring programmes, represent an important step forward, with regional and global implications. IPY includes several innovative community start-up activities that could stimulate and enhance collaboration and connection between science and society, and which can in turn provide the basis, and advocacy, for sustained Arctic research activities.

29. Impacts of Hydrologic and Climatic Change on Domestic Water Supplies in the Arctic

Molly Chambers, Daniel White, Larry Hinzman, Robert Busey, Erin Strang

In the past 30 years, the climate in the Arctic has warmed appreciably and there is evidence for a significant polar amplification of global warming in the future. While recent studies suggest that climate change will have a significant impact on arctic hydrology, very little evidence is available to predict how the quality and quantity of freshwater available to humans for domestic and subsistence use is likely to change. Coupled with regional-scale environmental dynamics are local-scale human behaviors and resulting activities in response to perceived change, available technologies, and existing policy infrastructures. The objective of this research is to understand how humans rely on freshwater at local scales in selected parts of the Arctic, how these dependencies have changed in the recent past, and how they are likely to change in the future.

We are developing a model that will allow better prediction of climate-induced changes in the hydrologic cycle, particularly at local scales, and the resulting consequences to humans. This study is being conducted on the Seward Peninsula where clear climate induced changes in the hydrologic cycle are already being observed. We are including community collaboration, historical documentation, field observations, laboratory experimentation, and agent-driven computer modeling to achieve the project goals. The sensitivity of water sources is being evaluated based on watershed area, groundwater contribution (based on conductivity data) and projected permafrost change as well as microbial safety of the water. This paper presents a summary of water vulnerability studies on the Seward Peninsula.

30. Winter Chemistry of North Slope Lakes

Molly Chambers, Daniel White, Michael Lilly, Larry Hinzman, Kristie Hilton

Lakes are important water resources on the North Slope of Alaska. Oilfield exploration and production requires water for facility use as well as transportation. Ice road construction requires winter extraction of fresh water. Since most North Slope lakes are relatively shallow, the quantity and quality of the water remaining under the ice by the end of the winter are important environmental management issues. Currently permits are based on the presence of overwintering fish populations and their sensitivity to low oxygen. Sampling during the winter of 2004 – 2005 sheds light on the winter chemistry of several pumped and unpumped lakes on the North Slope. Dissolved oxygen, conductivity, pH, and temperature profiles were taken along with ice thickness and water depth measurements. Water samples were extracted and analyzed for laboratory chemistry parameters. The summarized data provides a view of North Slope lake chemistry trends, while continued studies investigate the chemical impacts of pumping North Slope lakes through continued sampling and modeling efforts.

31. International Polar Year Youth Steering Committee

Amber Church, Tyler Kuhn

The International Polar Year (IPY) 2007-2009 will be a coordinated global effort involving more than fifty countries world-wide to focus research attention and public interest on the world's Polar Regions and the issues facing these areas. The IPY Youth Steering Committee (YSC) was created to address the needs of involving the youth of the world in this endeavour.

The International YSC is made up of youth representatives from around the world, from science, social science, aboriginal and arts backgrounds and ranging in education from post-doc to high school. These national representatives are responsible for providing the link between the International YSC and their country's national level YSC. National YSC's are in turn composed of regional representatives who undertake IPY outreach within their region. National YSC's coordinate countrywide initiatives to try and involve youth in IPY, with special focus on involving youth in actual IPY research programs. The International YSC as a whole tackles programs too large for any single national YSC.

One of these programs is the International Youth Conference on the Poles (IYCP). This conference, which will take place in May 2008, will bring together youth from around the world to focus on polar issues. IYCP will feature special sessions highlighting youth polar research and roundtable discussions in which youth will assist in directing international policies on polar issues. The conference will also feature a polar fair, providing a venue where youth can learn more about the Polar Regions and organizations operating in these areas and for artistic expression.

The Polar Contests is another YSC program. Young polar researchers are being recruited to design educational materials based on their work. Teachers will use these materials in classrooms to encourage their youth to participate in their regional level polar contests. Their entries will be based on what they have learned and can take any format: art, drama, writing, science experiments, etc. The regional winners will proceed to national level contests, have their work displayed in a national museum and compete for the opportunity to display their work in the IYCP Polar Fair.

An International YSC website has been developed. When completed it will provide a forum where youth will be able to communicate with each other globally and get involved in IPY programs. A major feature of this site will be the education center that is currently under construction. Here youth will be able to learn more about a wide variety of polar topics and will be able to download materials that they can employ to teach their peers and communities about these issues.

YSC has partnered with Students on Ice (SOI), a non-profit organization providing students with the opportunity to experience the poles first-hand. A series of nine SOI-IPY YSC expeditions to the Arctic and Antarctic will take place over the course of IPY, allowing hundreds of students from around the world to experience the Polar Regions first-hand, learn from experts working in these areas and become inspired to work for their continued protection.

YSC will coordinate a program where youth from around the world are given the opportunity to connect with and interview the participants of the International Geophysical Year (IGY). This will give IGY participants the opportunity to share their experiences and insights with the next generation of polar researchers, and in turn provide the upcoming generation with a sense of polar history and a different perspective on the polar world. These interviews will ultimately be presented in book or documentary form at the close of IPY.

YSC has been asked to document the legacies that the world's youth feel should result from IPY. This list of legacies will ultimately be used to monitor the progress of IPY and at its close in 2009 determine its effectiveness.

YSC has partnered with the science fiction educational book series, *Tales of the Wonder Zone*, to release *Polaris: A Celebration of Polar Science*. Youth and professional authors from around the world submitted stories based on an IPY fifty years in the future. Those submitting stories needed to research past and present IPY's in order to learn the current state of polar research and the amount that research changes between subsequent IPY's. This volume is now in the review stages and will be released for the start of IPY.

Through these programs and others YSC will reach out to youth who may not take an interest in science or the poles or who chose not to undertake post-secondary education. The YSC will serve as a voice for youth on polar issues and empower youth to get involved in issues facing the Polar Regions. YSC will work to draw the World's attention to the poles and act as a force for positive change. YSC will enlist media, corporations and world organizations to help attain these goals.

The ultimate legacy left by the YSC will be the continued interest and research focus on the Polar Regions beyond the conclusion of IPY. YSC will form a network of polar researchers, policy makers and leaders who will continue to work in and for the poles long past 2009.

32. A Simple System Dynamics Model of the Growth of a Species which Depends upon the Carrying Capacity of its Habitat

Henry Cole

A simple system dynamics model is presented which depicts the quantitative growth and decline of a dominant species which depends upon the existence and health of its principal food source. The food source depends in turn upon its own need for nutrients and water. When the consumption of the habitat exceeds its carrying capacity for that species the species will gradually decline as the habitat diminishes. The value of a system dynamics model lies in being able to represent and explicitly understand these inter-relationships and test the strength of the dependence of the species upon habitat. Such a model or its variations could be used to explore policy options.

33. Exploring the Benefits, Problems, and Effectiveness of a Distance Delivered Nursing Program in Alaska

Carol Coose

This study explored the benefits, problems and effectiveness of educational delivery methods utilized in the AAS nursing program at the University of Alaska Anchorage. The study measured last semester students' and graduates' perceptions of the benefits, problems and effectiveness of the delivery methods used in their nursing education. Participants in the study included traditional on-campus graduates as well as those from Outreach sites (where course content was delivered through distance-delivery methods). Methodology of the study included the use of a survey instrument, plus a comparison of student achievement data to further examine effectiveness. The survey instrument obtained demographics, as well as participant perceptions, through the use of Likert scale items and narrative statements. Analysis indicated the survey instrument demonstrated adequate reliability (Cronbach's alpha > .60). Analysis of data included descriptive and comparative statistics on student perceptions, between participants from Outreach and the traditional on-campus delivered program. There were no statistically significant differences between on-campus and distance-delivery participants' mean responses on two of the three total variable scales created for the study (benefits and effectiveness). However, relative to problems the Outreach participants evidenced statistically significant lower ratings ($p = .00$), indicating that they perceived more problems associated with delivery methods than did the on-campus group. Qualitative narrative responses corroborated the quantitative findings. There were no significant differences found between the Outreach and on-campus participants' scores for any of the eight student achievement assessments examined. This leads to the conclusion that there was 'no significant difference' in terms of effectiveness (as evidenced through student achievement data or student perceptions) between the distance delivered and traditional on-campus delivered AAS nursing program.

34. Physical Variables of the Non-Sorted Circle Ecosystem along a Bioclimatic Gradient in the Western North American Arctic Tundra

Ronald Daanen, Vladimir Romanovsky, Donald Walker

A recent biocomplexity study along a bioclimatic gradient in the North American Arctic Tundra has resulted in high quality physical data. Observed were: air and soil temperatures, soil moisture, soil heave and snow depth. Temperature and moisture stations have been installed from south to North at: Happy Valley, Sagwon Hills, Franklin Bluffs, Deadhorse, West Dock, Howe Island, Green Cabin and Mould Bay. In addition data has been collected on non Sorted circle soil movement due to cryoturbation or differential heave. A conceptual model has been developed to describe the behavior of non sorted circles along the climate gradient.

35. Complexity of Non Sorted Circle Ecosystems in the Arctic Tundra of Kodiak Island, Alaska

Ronald Daanen, Debasmitta Misra, Howard Epstein, Donald Walker

Climate warming is expected to alter the Arctic tundra ecosystem that is predominated by patterned ground, which is the result of an intricate equilibrium relationship between the hydrology, vegetation and soil processes. The hydrological system in the arctic depends strongly on the annual energy budget through freeze and thaw cycles. An increase in the energy budget would affect the annual water cycles, change biogeochemistry and soil processes, which in turn would change the patterned ground ecosystem, thus impacting the existing equilibrium. In this study, we concentrate on the hydrology of the non-sorted circle system, which is an example of a patterned ground in equilibrium condition. The objective of the study is to model the processes governing the liquid water movement in the active layer during freezing and to model vegetation succession in order to identify driving forces that change the equilibrium in the system. Vegetation patches cause preferential ice accumulation in adjacent non vegetated areas, which prevents vegetation succession in these areas. From our model simulations, we found that water redistributes within the active layer during freezing based on soil temperature differences. The redistribution of water during freezing can generate a pattern that resembles the observed pattern in the Arctic. Smaller temperature fluctuation with time reduced the water movement to the center of the non-sorted circles. Potential changes in vegetation succession on the non sorted circles also reduced the water movement to the center of these feature resulting in a more pronounced shift from the equilibrium condition.

36. Rapid Treeline Change in southwest Yukon during the mid-20th Century: Dendroecological and Photographic Evidence

Ryan Danby, David Hik

The boundary between forest and tundra, generally referred to as treeline, is widely anticipated to change as a consequence of climate warming. We examined recent treeline dynamics at six topographically different, but climatically similar, sites in southwest Yukon, Canada, in order to understand how treeline has responded to past climate change. Dendroecological techniques were used to reconstruct changes in density of the dominant tree species, white spruce (*Picea glauca*). Data indicate that treeline elevation and stand density increased significantly during the early-mid 20th century but that change was not uniform across all sites. Spruce advanced rapidly on south-facing slopes and treeline rose 65 to 85 m in elevation. Treeline did not advance on north-facing slopes, but stand density increased 40 to 65 percent. A standardized, GIS-based, comparison of the earliest aerial photographs of the region (taken in 1947) with the most recent (taken in 1989) supports these results. An absence of major natural disturbances combined with a strong correlation between increases in stand density and reconstructed summer temperatures points to climate as the cause of change. Our results demonstrate that treelines can change rapidly in response to climate warming, but that the pattern and timing of change is mediated by finer scale variables, as well as species' biology. These variables therefore need to be considered when forecasting future change.

37. Fate of Exported Soil Organic Carbon from the Eroding Coastline of Northern Alaska

Fugen Dou, Laodong Guo, Chien-Lu Ping, Gary Michaelson, Torre Jorgenson

Coastal erosion in Arctic regions has become a major pathway of organic carbon (OC) transport across the land/ocean interface under a warming climate and may significantly influence the C budget and biogeochemical cycle in the Arctic Ocean. The erosion of northern Alaska coastline not only losses thousands acres of land to the ocean each year,

but also contributes to the magnitude of OC to be potentially mineralized. In this study, soil physical fractionation was used to simulate this process and to separate SOC into different pools with emphasis on DOC characteristics in two selected sites (ASC9 and Line 13). Although the two sites had similar SOC and DOC contents, they showed different distribution patterns with depth. Compared to ASC9, Line 13 contributed more labile C which also was consistent with UV absorption of DOC. The primary results indicate that relative biological property of SOC may vary with depth. Further study is needed to better describe variation of the turnover of eroded SOC.

38. Use of Landfast Sea Ice as a Platform for Subsistence Whaling in a Changing Environment

Matthew Druckenmiller, Hajo Eicken, Craig George

The spring whale harvest throughout Arctic Alaska is a prime example of the use of sea ice as a platform for human activities. Whaling trails are cleared through the highly deformed landfast ice to allow whaling crews to position themselves along open leads in wait for the migratory passage of bowhead whales—an important cultural and subsistence resource for many Iñupiaq Eskimo communities. In Barrow, wildlife biologists with the North Slope Borough have geographically referenced whaling trails in years 2003–2006; however, a thorough collection of this data along side detailed information about ice conditions has yet to be initiated. Here we examine a subset of this data in conjunction with information about landfast ice conditions obtained from analysis of remote sensing and ground-based observations. This preliminary work holds promise for a multi-year comprehensive documentation of trail data, such as trail location, density, tortuosity, and construction effort, in relation to sea-ice conditions (e.g., landfast ice stability, topography, and sea-ice concentration) and weather (e.g., seasonally dominant wind speed and direction as well as ocean currents), thus providing insight into the factors that play a role in trail construction. Data correlations may assist in assigning a relative importance factor to various types of local sea-ice knowledge that are employed during the spring whale harvest. Looking forward toward the development and refinement of coastal sea-ice observational tools for stakeholders, this analysis may help ensure that such resources address stakeholder interests. This data may also provide information on the temporal and spatial scale of sea-ice observations and predictions needed to inform the whole of a whaling community. As of the 2006 ice season, data on sea-ice conditions is being provided by Radarsat satellite imagery and the Barrow Ice Observatory's land-based X-band marine radar (a component of the Alaska Ocean Observing System)—a tool that currently provides Barrow residents with near-real-time information on coastal sea-ice conditions. Since various factors play a role in trail construction, interviews with sea-ice and whaling experts of the Barrow community will be important. In extending this small pilot study we plan to gain insight into how large-scale changes in the sea-ice environment impact subsistence hunting and other human activities on a regional or local scale.

39. Nenana in Canada? The Archaeology of the Little John Site (KdVo-6), Yukon Territory, 2001 - 2006

Norman Easton, Glen MacKay, Patricia Young

The Little John site (KdV0-6) lies on a knoll overlooking the upper Mirror Creek valley, the easternmost tributary of the Tanana River, about five kilometers from the Yukon - Alaska border. Excavations here since 2001 have exposed five principal components spanning the entire known history of the region: Historic, Late Prehistoric, Northern Archaic, Northwest Microblade / Denali, and Nenana, the latter evidenced by chindadn (tear-drop) points and biface technology in loess over bedrock regolith, overlaid by a microblade bearing brunisol level. Two discrete areas of the site display different sediment deposition, one shallow (c. 30 cm) the other deeper (c. 110 cm). The deeper deposits contain a series of organically rich paleosols holding a variety of faunal remains and lithic tools. These deposits have been radiocarbon dated to c. 8 - 9,000 BCE. No dates for the shallow area of the site have been possible. This paper will provide an overview of the work at the Little John site since 2001 and report on the findings of the 2006 field efforts, including new radiocarbon dates as available.

40. Socio-Economic Change and Human Well-Being in the Context of a Thinning and Shrinking Western Arctic Sea-Ice Cover

Hajo Eicken, Amy Lovcraft, Matthew Druckenmiller, Andrew Mahoney

The western Arctic has experienced a drastic reduction of sea ice thickness and extent in the past few decades. The change in seasonal sea ice coverage is part of a suite of complex ecological and social changes affecting marine and coastal sectors of the Arctic. These changes will directly affect the well-being of people and industries dependent

upon the ecosystem services provided by the sea-ice system in the North. Our analysis sets out to explore how the transformations in the sea-ice environment are tied to broader changes in social-ecological systems across the North. We ask two interrelated questions: (1) is the available information about past, current and future sea-ice change adequate and of sufficient accuracy to inform and guide decision-making by planners at the local, regional and global level? (2) How can stakeholder interests help guide the design of an Arctic sea-ice observation network that addresses private and public needs, thus ensuring human well-being? Our research answers these questions using interdisciplinary methods drawing from both natural and social sciences to determine what information is present, who depends upon sea-ice information, and how an observation network can best be implemented to promote multiple interests.

At the pan-Arctic scale, remote-sensing data and field observations have shown a reduction in summer Arctic ice extent by approximately 7 % over the past three decades, with a corresponding thinning by as much as 40 %. Climate models suggest that these changes are the early stages of a substantial reduction or potential elimination of Arctic perennial ice by the end of the century. These models, however, are not yet able to realistically simulate key sea-ice processes, which limits their usefulness for planners and stakeholders. Even large-scale satellite data have limitations as is illustrated by a comparison between ice climatological data and an ice severity index for the Barrow region. It is not clear at present, to what an extent recent attention given to economic development in Arctic marine environments is at least in part driven by an inadequate understanding of the limitations or errors inherent in projections of Arctic marine environmental change. However, it could be argued that synergistic effects in the geopolitical, socio-economic and scientific-technological realm provide enough momentum for activities to advance into sectors that were previously considered too challenging or uneconomical. For example, we argue that oil and gas development in the Sea of Okhotsk may serve as an instructive model of such synergistic development efforts and may hold significant lessons for future ventures in Alaska.

In responding to the challenges and opportunities of the complex of changes underway in the North, there is an increasing need for adequate and accurate information about the present state of the environment and its evolution. Recognition of this need has led to efforts throughout the circum-Arctic to plan for an Arctic Observation Network that is responsive to the needs of both the scientific and stakeholder communities. For example, the vast body of indigenous expertise and knowledge of the relevant processes holds significant predictive power at timescales currently not well addressed by models. At the same time major multinational industries, such as oil and gas, have needs that drive information collection. In designing such a network, the challenge lies in balancing scientific and stakeholder needs in the context of limited resources. A successful approach requires a high degree of international collaboration but also a theoretical underpinning that allows for the development of an observing network that is both lean and effective. Based on our preliminary research we argue that the concept of (ecosystem) services provided by the sea-ice cover in conjunction with a bottom-up approach (scaling up from local observations and expertise) is a viable path towards implementation of such a network.

41. Energy Feedbacks to the Climate System Due to Reduced High-Latitude Snow Cover During 20th Century Warming

Eugenie Euskirchen, A. David McGuire, F. Stuart Chapin III

The warming associated with changes in snow cover in northern high-latitude terrestrial regions represents an important energy feedback to the climate system. Here, we simulate these radiative forcings across the Pan-arctic over two warming periods during the 20th Century, 1910 -1940 and 1970 – 2000. We offer evidence that increases in heating caused by decreases in high-latitude snow cover associated with warming during recent decades are nearly twice as large as during a warming period in the early 20th Century, when the anthropogenic contribution to warming was smaller. Furthermore, we found distinct differences in snow return and snow melt dates between the two periods of analysis, with the earlier period marked by increased autumn temperatures and later snow return, whereas the later period was associated with warmer spring temperatures and earlier snowmelt. Consequently, changes in atmospheric heating from 1970-2000 compared to 1910-1940 were magnified relative to changes in snow-cover duration because changes in the atmospheric heating of snow-covered and snow-free ground were greater in spring than in autumn. Large differences in atmospheric heating were also noted between the vegetation types with high albedo contrast (e.g., tundra) and low albedo contrast (e.g., forests) even if they exhibited similar changes in snow cover duration. These changes in energy exchange appear to be approximately 20 times larger than climate feedbacks associated with changes in carbon sequestration in terrestrial ecosystems, and therefore warrant careful consideration in studies of climate change, particularly with respect to associated shifts in vegetation between forests, grasslands, and tundra.

42. Alaskan Reindeer and Caribou Prefer Lichens that are Low in Protein and High in Toxins

Adelia Falk, Peregrine Barboza, Thomas Green

Lichen dominate the land cover in many arctic and sub-arctic communities. Caribou and reindeer (*Rangifer tarandus*) often rely upon lichen in late-winter when food abundance is low and when females enter the last trimester of pregnancy. We collected 9 species of lichens from 55 sites in central Alaska to characterize the quality of this winter forage for Rangifer. Preferred species of lichen (*Cladonia*, *Cladina* and *Flavocetraria* sp.) were low in N ($0.39 \pm 0.33\%$), and S ($0.03 \pm 0.02\%$). Species that are rarely consumed by Rangifer (*Nephroma* and *Stereocaulon* sp.) contained more N ($1.17 \pm 0.55\%$) that probably included unpalatable nitrates. Preferred species of lichen also contained the highest concentrations of the toxins usnic acid (7.97 ± 1.00 mg/g dry) and perlatolic acid (1.06 ± 0.29 mg/g dry). Altitude and latitude affected N and S within all species, and toxin concentration within *Cladina* species. Selection of lichens by Rangifer may vary with location and with the relative concentrations of toxins and nutrients. For example, gains of C from carbohydrates in preferred species must balance the cost of detoxification by the animal. Foraging behaviour of Rangifer in winter may therefore change with nutrient balance and toxin load from the plant community.

43. Cloud Cover and Surface Air Temperature Correlations over Northern High Latitudes

Xingang Fan, Daqing Yang, John Walsh, Jeremy Krieger

Three-hourly cloud cover data from the International Satellite Cloud Climatology Project (ISCCP) D1 dataset and station observed surface air temperature (SAT) data over a 22-year time period (1983-2004) are analyzed. Significant correlations between cloud cover and SAT change is found over high latitude land area. The extent to which the cloud cover affects the SAT is quantitatively described and presented. In winter time, the cloud cover causes SAT increase while the clear sky follows by SAT decrease. On the contrary, in summer time, cloud cover causes SAT decrease and clear sky causes increase of SAT.

44. Investigation of the Relationship Between the Timing and Magnitude of Spring Pollen Release of Various Interior Alaska Species and Various Meteorological Parameters

Ted Fathauer

Data on airborne pollen concentrations during the spring and early summer in 23 years were gathered for four species. Meteorological data was gathered for each of these seasons, starting in the previous fall and continuing through the pollen season. This investigation demonstrates that some meteorological parameters have little relation with either the timing or the magnitude of a season's pollen release, while there is varying correlation with other parameters. One problem in this analysis is the inter correlation of some parameters, e.g., temperature and precipitation.

45. Inhibiting Serotonergic Neurons Abolishes Hypercapnic Ventilatory Sensitivity in the Unanaesthetized in Situ Perfused Rat Brainstem Preparation

Deborah Fieldman, George Richerson, Michael Harris

The role of serotonergic neurons as important CO₂ sensitive chemoreceptors in vivo is a topic of debate. Our studies were designed to determine the impact of 5-HT neuromodulation on ventilatory chemoresponses, using an unanaesthetized in situ perfused rat brainstem preparation. We tested the hypothesis that serotonergic neuron activity is critical for the adjustments in eupneic phrenic burst discharge patterns that normally occur in response to hypercapnia in this preparation. Chemoresponses were assessed by recording the change in phrenic discharge patterns induced by increasing CO₂ of the gas equilibrated with the perfusion solution from 5% to 7% (balance O₂). This preparation demonstrates changes in eupneic phrenic burst patterns with hypercapnia that are similar to hypercapnic ventilatory responses in vivo. Changes in burst pattern were compared before and after application of the specific 5-HT_{1A} receptor agonist 8-hydroxy-(dipropylamino) tetralin hydrobromide (8-OH-DPAT) into the perfusate (0, 1.5, 3 and 6 μ M), which we assume causes inhibition of 5HT neurons via autoreceptor activation. The response to hypercapnia was abolished by 8-OH-DPAT treatment. These results suggest that 5HT neurons are critical for CO₂ chemosensitivity in this unanaesthetized rat preparation, and support the importance of 5HT neurons in CO₂ chemosensitivity in vivo.

This research was supported by the NIH, NINDS Office of Minority Health Research SNRP program, and the NSF

Alaska EPSCoR.

46. Underground Tunnel in Permafrost and Genesis of Multi-directional Reticulate Ice Veins in Permafrost

Daniel Fortier, Mikhail Kanevskyi, Yuri Shur

EPSCoR Poster

47. Old Wine, New Bottles: Archiving George MacGinitie's Arctic Marine Invertebrate Data

Nora Foster

In the late 1940's George MacGinitie, a prominent marine ecologist, documented the presence of marine invertebrates in the Beaufort Sea off Point Barrow, Alaska. His notes and photographs record details of the distribution, life history, abundance, feeding habits, and parasites of over 200 species in 12 phyla. Much of his observations are recorded and interpreted in the classic Smithsonian publication, *Distribution and Ecology of the Marine Invertebrates of Point Barrow, Alaska*. In the late 1990's, when the NARL lab closed, several boxes of specimens and other material were donated to the University of Alaska Museum of the North. Among the miscellaneous material were MacGinitie's original notes and approximately 100 original annotated photographs. With funding from the Census of Marine Life's Arctic Ocean Biodiversity Program Arctic minigrant program, I have begun a project to assure that original notes, and photographs, as well as the ecological information that can be derived from them will remain easily available through the UA Museum's ARCTOS database website and through OBIS, the Ocean Biogeographic Information system.

48. Changes in the Fabric of the Arctic's Greenhouse Blanket

Jennifer Francis, Jaclyn Trzaska, Elias Hunter

The only thing that has been constant in the Arctic during recent decades is sweeping change. Observations of almost every aspect of the climate system suggest a cohesive shift toward an Arctic with warmer temperatures and less permanent ice, the most conspicuous indicator being the loss of perennial sea ice. Our recent analyses of satellite-derived dynamic and thermodynamic forcing parameters suggest that anomalies in downwelling longwave (infrared) radiation fluxes (DLF) explain the most variance in summer sea ice extent in six peripheral seas around the Arctic Ocean [Francis et al., 2005; Francis and Hunter, submitted]. We also observe significant increases in DLF in spring through autumn over most of the region, pointing to DLF as an important driver of sea ice loss. What is unclear, however, is which of the many possible atmospheric variables are causing DLF variability and change? In this presentation we examine the contributions of varying temperature, cloud properties, and precipitable water to DLF changes using measurements from the ARM site at Barrow, AK, and extend this analysis to the pan-Arctic using retrievals from satellite sounders.

49. Forest Carbon and Social-Ecological Systems in Interior Alaska: Placing Historical, Landscape-Level, and Local Analyses into a Resilience Context

Nancy Fresco, F. Stuart Chapin III

Northern ecosystems and the people who rely upon them are facing a time of unprecedented rapid change due to anthropogenic climate change and cultural and economic pressures. Global boreal forests will play an important role in the feedback loop between climate, ecosystems, and society. In this analysis, we examine forest carbon management in Interior boreal Alaska in the context of social-ecological resilience. We first create a framework in which to assess components of system resilience, and then examine how these components are likely to be affected by regional history, management infrastructure, climate change, and policy responses to climate change. We draw upon an assessment of historical land use and management and current regulatory frameworks; Alaska-based outputs from the Carbon Budget Model for the Canadian Forest Sector (CBM-CFS3); and a case study in carbon management through small-scale local fuel offset programs. Our results show system characteristics that tend to bolster resilience as well as features that tend to increase vulnerability. On one hand, low population density, limited fire suppression, and restricted economic expansion in Interior Alaska have resulted in a 21st-century landscape with less compromised human-ecosystem interactions than other boreal regions. Relative wealth and a strong regulatory framework also put Alaska in a position to manage for long-term objectives rather than short-term needs. Moreover, the possibility of successful village-based biomass fuels projects appears promising. However, northern latitudes are likely to be vulnerable to radical change due

to exaggerated climate change and low species diversity, and CBM-CFS3 results indicate that Interior Alaska could switch from being a net carbon sink to a source in the next hundred years, depending on the impacts of ongoing climate change and altered fire cycles. Based on these mixed prospects for resilience, we conclude that land managers and local communities can potentially bolster social-ecological resilience and help to balance regional carbon dynamics through integrated management of fire, forestry, subsistence, and local energy generation. We argue that in order to reduce vulnerability to rapid change, management goals for Alaska's boreal forest must be long-term, flexible, cooperative, and locally integrated

50. www.arctichealth.org, the Source for Health Information for People of the Arctic

Christy Garrett

Each day, people in the communities of the Arctic face challenges to their health and well-being from changing climatic and environmental conditions and increasing levels of pollution to emerging infectious diseases. For this reason, it is critical that Arctic residents have access to timely, accurate, and relevant information addressing their unique health concerns. To meet this need, the National Library of Medicine (NLM) and the University of Alaska Anchorage (UAA) have developed the Arctic Health website, www.arctichealth.org.

The website provides an easy-to-use one-stop shop for information on the diverse health-related aspects of the Arctic region. It is organized around relevant topics, including traditional healing, telehealth/telemedicine, and environmental health. The Arctic Health website provides links to the most reliable resources available from local, state, and international agencies, universities, and professional organizations.

Two major goals of the site are to create a comprehensive, accessible repository for various media and a listing of research projects, past and present that relate to human health in the Arctic. To increase the site's relevance, the project has established and continues to create collaborations with researchers, communities, and other organizations to supply publications not available elsewhere, including gray literature, streaming video of traditional healers, and oral histories. These collaborations will also help ensure a database with a comprehensive list of research projects being done in the Arctic, from the international to the local level. This site also hosts the Arctic Human Health Initiative (AHHI), the human health focus of the International Polar Year activities.

51. Volume Change of Brooks Range Glaciers 1956-2004

Jason Geck, Matt Nolan

Utilizing a Geographic Information System (GIS) method, we are calculating volume change of a large number of glaciers within the eastern and Central Brooks Range, Alaska. This method consists of differencing elevations between USGS maps (1956-1972) and recently acquired Star3i airborne SAR DEMs (2001). The resolution of the recent DEMs is 10m with a vertical accuracy of about 1 m. Current (>2005) glacial extents are derived from satellite imagery (ASTER, Quickbird) allowing past and current area differences. Preliminary results suggest widespread volume loss within glaciers evaluated, and that the rate of volume loss is increasing with time at those locations where we have more than two elevation measurements to compare.

52. Magnetic North: Collaborative Cyber Explorations

Mary Goodwin

The circumpolar region has attracted a number of contemporary artists who engage in networked art projects. Some are site-specific installations which integrate scientific data-streams: Jane Marsching's Data Mining the North at the Maryland Gallery and John Luther Adams' Place Where You Go to Listen at the University of Alaska Museum of the North. Yet, networked art also includes projects that are truly everywhere and nowhere at the same time, such as the Art on the Grid recitals spearheaded by UAF professors Miho Aoki and Scott Deal which bring globally-dispersed souls together to perform art, music, and dance on-line in synchrony.

An early example of circumpolar Northern networked art is Lars Vilks' cyber-country of Ladonia. In the 1980s, before the global Internet, Vilks oversaw collaborative site-specific nature installations. In 1996, to protest the attempts by Swedish authorities to censor some large works of natural materials, the artist declared a one square kilometer

peninsula site the nation of Ladonia. The nation formally seceded from Sweden, declaring the sculptures "national monuments." At the same time, Vilks established Ladonia as an Internet presence. Today, Ladonia has more than 11,000 citizens who collaborate, vote, and share cyber and "cyber-physical" events. As an artist, Vilks' concerns are as much social as environmental. His actions with and within nature's sphere are designed to provoke media debate over issues of nature and culture, public and private property, wilderness and natural resource development, and intellectual property rights.

This paper will explore a cross-section of collaborative cyber-artists whose concerns intersect with those of scientists in the North.

53. The Dynamics of the Sea Ice Community during the Canadian Arctic Shelf Exchange Study in Southeastern Beaufort Sea

Michel Gosselin

The Canadian Arctic Shelf Exchange Study (CASES) is an international effort under Canadian leadership to understand the biogeochemical and ecological consequences of sea ice variability and change on the Mackenzie shelf. From September 2003 to July 2004, researchers from the Department of Fisheries and Oceans, the Canadian Museum of Nature, the University of Connecticut and the University of Quebec at Rimouski combined their efforts to study the dynamics of the sea ice communities during the period of development and decline of the ice cover. We investigated: (1) the incorporation of bacteria and protists in newly formed sea ice, (2) the seasonal dynamics of bottom ice algae and of exopolymeric substances (EPS) in first-ice landfast ice, (3) the photoproduction of carbon monoxide in sea ice and (4) the relationship between ice algal standing stock and benthic respiration. Results from these studies will be presented. This project will help to improve predictions on the impacts of climate change on carbon cycling in Arctic marine communities.

54. Arctic Ocean Diversity (ArcOD), a Census of Marine Life project

Rolf Gradinger, Bodil Bluhm, Russ Hopcroft

The Arctic climate is changing at a tremendous rate, which makes efforts to identify the diversity of life in the major three realms (sea ice, water column and sea floor) of the Arctic an urgent issue. Current knowledge indicates that the Arctic seas hold a multitude of unique life forms adapted to the extremes of that environment. The Arctic Ocean Diversity (ArcOD) project is a field project of the Census of Marine Life (CoML) program. CoML is a growing global network of researchers in more than 70 nations engaged in a ten-year (2000-2010) initiative to assess and explain the diversity, distribution, and abundance of marine life in the oceans, past, present and future. Within CoML, ArcOD is an international effort to inventory biodiversity in the three major Arctic realms, sea ice, water column, and sea floor - from the shallow shelves to the deep basins using an international Pan-Arctic approach. ArcOD is using a three-step approach: compilation of existing data, taxonomic identification of existing samples, and new collections focusing on taxonomic and regional gaps. ArcOD has been selected as a cluster lead project during the International Polar Year

55. Implications of Environmental Changes for the Arctic Marine Ecosystems

Rolf Gradinger, Bodil Bluhm

The Alaskan Arctic marine environment has experienced tremendous changes over the last decades with e.g. reduction of summer sea ice properties, water mass distribution and freshening of the surface layers in the Chukchi and Beaufort Seas. Little is known about the impacts of such changes on the diversity of life and the functioning of these marine ecosystems. Proposed changes range from increases in productivity and biomass to extinction of species. Our presentation will focus on a description of the marine ecosystems based on data collected from fast ice covered near shore regions to the multi-year ice covered deep Canada basin, and we will present scenarios to exemplify how changes in the environmental settings can influence the marine ecosystems in the Chukchi and Beaufort Seas.

56. Caretakers of the Land

Kathleen Graves, Pat Frank

Across the continent are indigenous peoples who are connected the land and nature. It is through their voices that nature can speak. They are the care takers of the land. The wisdom keepers or spiritual leaders tell us that the path of

Western technology is separated from the natural and spiritual law which is creating chaos.

While many Westerners maintain respect for the wisdom of the Elders and caretakers of the land, some view this knowledge as dead and useless. On the other hand, many Native people have not abandoned the ancient wisdom from the past, which comes from the ancestors through the Elders. The caretakers of the land have an instinctual desire to protect the earth. They live in harmony with nature and ancestral wisdom.

Alaska Native people are observing changes in their day to day lives and are expressing concern over the sudden variation of climate conditions and the unpredictability of the weather. There has been a critical impact on the traditional lifestyle. Weather related changes and changes in the traditional cycle of the seasons are affecting the lives of Alaska Native people. They are witnessing the arrival of new species of insects, plants and birds. The late freeze up and the early spring makes movement on the tundra and lakes difficult. There has been erosion caused by new, strong winds.

Enhancing our awareness of the changes requires balancing the scholarly approaches to understanding environmental changes with the indigenous systems of knowing. Alaska Native Elders maintain systems of knowledge which hold the potential to improve knowledge of climate changes by honoring and listening to their knowledge as equal partners with Western science.

Alaska Native are observing and being affected by Arctic change and they maintain a substantial amount of pertinent knowledge. Alaska Natives are stakeholders and need to be engaged in the definition of questions, participation in research and interpretation of the findings. Alaska Natives are facing a complex set of social, economic and cultural changes which are directly linked to environmental changes. Alaska Natives living in rural Alaska are dependent upon the earth for their survival. They practice a subsistence way of life. Hunting and gathering activities provide continuity between generations.

57. Mice Selected for Excessive Nest-Building Behavior: A Potential Animal Model for Compulsive Disorders

Dana Greene, Kelsey Alexander, Dani Raap, Abel Bult-Ito

Bi-directional selection for thermoregulatory nest-building behavior in house mice has resulted in a 40-fold difference in the amount of cotton used for nest-building between the high and the low selected lines (big and small nest-builders, respectively). The repetitive nest-building behavior, characteristic of the big nest-builders, appears to be a compulsive-like behavior that is responsive to serotonin re-uptake inhibitor (SSRI) administration. Previous studies in our lab have shown that compulsive-like nesting behavior was attenuated by oral administration of the SSRI, fluoxetine, at 30, 50, and 100 mg/kg/day dose-dependently, as compared to a vehicle group. Previous studies have shown that compulsive symptoms in humans are reduced by SSRIs such as fluoxetine, however not by the tricyclic antidepressant desipramine. Compulsive-like nesting behavior was assessed in male big nest-building mice 4 weeks before, 4 weeks during and 4 weeks after oral fluoxetine, desipramine or vehicle administration (sucrose vehicle, 50mg/kg/day fluoxetine, 30mg/kg/day desipramine). Mice exposed to the 50mg/kg/day fluoxetine dose had a decline in nest-building behavior compared to the vehicle and 30mg/kg/day desipramine groups. No significant difference was found between the desipramine and sucrose vehicle groups. Therefore, desipramine did not change compulsive-like nest-building behavior in big nest-building mice, which is similar to the lack of an effect in human compulsive disorders. These data taken together with additional findings in these mice further support the big nest-builders as a model of compulsive behaviors in humans, which will provide the means to more clearly identify neurobiological pathways involved in compulsive disorders.

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58. Geological and Geomorphological Evolution of a Sedimentary Periglacial Landscape in Northeast Siberia During the Late Quaternary

Guido Grosse, Lutz Schirmer, Christine Siebert, Viktor Kunitsky, Elena Slagoda, Andrei Andreev, Alfred Wegener, Alexander Dereviagin

A wide variety of environmental records is necessary for analysing and understanding the complex Late Quaternary dynamics of permafrost-dominated Arctic landscapes. A NE Siberian periglacial region with a rich history of previous paleo-environmental research was studied in detail using sediment records, remote sensing data, and terrain modelling,

all incorporated in geographical information systems (GIS). The study area consists of the Bykovsky Peninsula and the adjacent Khorogor Valley in the Kharaulakh Ridge situated a few kilometres southeast from the Lena Delta. In this study a comprehensive cryolithological database containing information from 176 sites was compiled. The information from these sites is based on the review of previously published borehole data, outcrop profiles, surface samples, and our own field data. These archives cover depositional records of three periods: from Pliocene to Early Pleistocene, the Late Pleistocene, and the Holocene. The main sediment sequences on the Bykovsky Peninsula consist of up to 50 m thick ice-rich permafrost deposits (Ice Complex) that were accumulated during the Late Pleistocene. They were formed as a result of nival processes around extensive snowfields in the Kharaulakh Ridge, slope processes (e.g., in the Khorogor Valley), and alluvial/proluvial sedimentation in a flat accumulation plain dominated by polygonal tundra in the mountain foreland (Bykovsky Peninsula). During the early to middle Holocene warming, a general landscape transformation occurred from an extensive Late Pleistocene accumulation plain to a strongly thermokarst-dominated relief dissected by numerous depressions. Thermokarst subsidence had a large influence on the periglacial hydrological patterns, the sediment deposition, and on the composition and distribution of habitats. Climate deterioration, lake drainage, and talik refreezing occurred during the middle to late Holocene. Because of the post-glacial sea level rise, the sea reached the region during the middle Holocene, triggering thermo-abrasion of ice-rich coasts and the marine inundation of thermokarst depressions in the investigated area.

59. Recent Range Expansion of the Populus Associated Ectomycorrhizal Fungus, Tricholoma Populinum: Evidence from Nuclear and Mitochondrial Genes

Lisa Grubisha, Matt Olson, Lee Taylor

We are investigating the evolutionary history of *Tricholoma populinum*, an ectomycorrhizal mushroom-forming fungus that is an obligate mutualist with many *Populus* spp.. *Tricholoma populinum* is distributed across Europe, Scandinavia, North America, and Russia and may have survived in Beringian refugia during the last glacial maximum (>13,000 years ago). To test whether population genetic patterns are consistent with the presence of a Beringian refugium, we sequenced five nuclear loci and one mitochondrial locus from *T. populinum* specimens from Scandinavia, Alaska, western and central Canada, and the western United States. Sequence data indicate differentiation between Scandinavian and North American populations. Cryptic species were not detected in *T. populinum* either by host association (e.g., *P. balsamifera* or *P. trichocarpa*) or by geographic region in North America. In North America, a recent range expansion may explain the extremely low genetic variation among geographic regions.

60. Economic Resilience through Environmental Recognition: A Green Star Case Study Anchorage, Alaska

Jean Guzzetti, Gary Kofinas, Peter Fix, Laura Milner

The resilience of a system can be described as its capacity to survive a change or crisis without losing the integrity of the system. The Exxon-Valdez Oil Spill of 1989 was a crisis for both the environment and businesses. In Anchorage, the Chamber of Commerce, in partnership with the Alaska Center for the Environment and the Department of Environmental Conservation responded to this environmental and economic crisis by creating the Green Star Program. Through technical assistance and recognition, Green Star was designed to decrease an organization's environmental impact while improving its environmental image. Current membership includes over 270 schools, non-profits, government agencies, and for-profit businesses. Now, with the Oil Spill 17 years in the past, and Green Star 16 years into its future, the role of this Alaskan environmental recognition program is explored. Does Green Star continue to provide services that lend themselves toward the resilience and sustainability of local businesses in response to changing environmental systems? Have the perceptions of environmental "crises" changed since the creation of Green Star? Are businesses more concerned with environmental image, environmental cost, or environmental impact? Content analysis of Green Star records indicate if the frequency of terms describing environmental issues such as waste management, pollution prevention, recycling, and energy efficiency change over time. Through mail-out questionnaires and member interviews, it appears that businesses are no longer primarily concerned with the positive publicity Green Star offers, suggesting that participation is motivated by concepts other than environmental image.

61. Recent Climate Fluctuations at Thule, NW Greenland: Implications to Catchment Hydrology and Geochemistry

Birgit Hagedorn, Ronald Sletten

The 50+ year climate record from Thule Airbase, located on Pittuffik peninsula in NW-Greenland, indicates increasing air temperature which is most pronounced during winter. In contrast, amount of summer and winter precipitation appears random but may point to increases in extreme events. For example, the first reported flood events that threaten facilities of the local Air Force Base due to high summer precipitation occurred in 1998 (90 mm) and in 2001 (210 mm). Since 2003 we have witnessed extreme events each year. In 2004, late summer rain amounted to 98 mm which is the second highest rainfall event since 1978. High winds during the winter of 2004-2005 caused extreme snow drifts on the Greenland Ice Sheet and in periglacial areas of the Pittuffik peninsula. The accumulated snow drifts on and near the Ice Sheet were released within 1 hour as slush flow avalanches due to warm winds and moderate rainfall. In 2006, break up and stream runoff started May 11, one month earlier than previously noted and was followed by high rains in second half of July.

Since 2004 we have conducted high resolution monitoring of discharge, water temperature, and water chemistry on three rivers which differ in catchment size, lithology, and water source. Two of the streams are mainly fed by melt water from local ice cap which is connected to Greenland Ice Sheet and drain a catchment area of 200 to 250 km² including the ice cap area. The third stream is fed by local snowmelt and rain only and its catchment area is 5 km².

In this presentation we present a high resolution set of hydrological and geochemical data from 2004 to 2006 from all three rivers along with climate, soil temperature, soil moisture, and groundwater measurements. We use these data to discuss the effect of climate fluctuations on river runoff and geochemistry as well as to evaluate associated catchment scale processes like permafrost thawing, release of dissolved organic and inorganic carbon, accumulation and dissolution of salts, and formation of melt water on ice cap.

62. Activation of 5HT_{1A} Receptors with 8-OH-DPAT does not Prevent Gasping but may Impair Auto-Resuscitation

Alexis Hansen, Michael Harris

In situ perfused brainstem models have been applied to the study of cardiovascular and respiratory regulation, but have not been used to investigate metabolic regulation. These models are well suited to physiological investigation as the neural circuitry involved in autonomic homeostasis is available for fine experimental manipulation. These preparations also produce a quantifiable output (heart rate variability; HRV) that may be used to assess autonomic tone. If validated, these models have the potential to allow studies related to the control of states such as torpor and hibernation, and to studies of metabolic regulation and the induction of states of reduced metabolism such as suspended animation. The appropriateness of this model for such investigations needs to be determined. We monitored HRV in our system using commercially available software (ADInstruments Powerlab HRV module), and identified HRV spectra that indicated active sympathetic and parasympathetic autonomic tone under resting conditions. Application of the sympathetic neurotransmitter adrenaline, the parasympathetic transmitter acetylcholine (ACH), and atropine (an antagonist of ACH receptors) produced appropriate changes in heart rate. HRV analysis subsequent to these applications demonstrated HRV spectra that correctly identified the autonomic nature of the manipulation. These results indicate that HRV analysis can identify changes in autonomic tone, and validate the use of HRV analysis in our model to assess the status of the autonomic nervous system. As such, this model can be applied to studies of autonomic regulation. Subsequent studies of using HRV to identify autonomic responses to physiological manipulations are underway and current results will be discussed.

This research is supported by an Undergraduate Student Project Award from Alaska INBRE.

63. The Role of Vegetation Succession in Animal Re-Colonization of a Recently-Deglaciated Fjord in Southeastern Alaska

Susan Hazlett, Bruce Molnia

Post Little Ice Age forest succession in Glacier Bay, southeastern Alaska, has been taking place since the mid-18th Century, following the rapid retreat of local glaciers. Succession is typically the advent of pioneer species such as dryas and mosses, followed by alder and willow thickets, and finally spruce and hemlock forests. Since the early

1880's, glacial retreat and subsequent vegetative and animal succession have been documented in photos and reports. We have reoccupied and photographed many of these sites, and have noted not only changes in vegetation, but the accompanying changes in animal habitat. Results show that the landscape of Glacier Bay has changed dramatically, and that these changes have had far-reaching effects on animal and human habitation in the bay. The Tlingit people were driven from their traditional home in the bay by the Little Ice Age advance of the glacier. As the glacier retreated they returned to hunt seal and also collect available traditional foods. However, permanent settlement would have been dependent upon a sufficient wood source to supply the cooking and heating needs of a village through the winter. Understanding variations in succession can aid management in predicting changes in habitats under different climactic conditions and evaluate sustainability of local resources. By understanding the connections between vegetative succession and changes in habitat as documented through photographs and reports, we built a conceptual model that assists in predicting future changes and promoting an understanding of how climate change can affect contemporary landscapes.

64. SEAMONSTER: Development of a Sensor Network for Southeast Alaska Science

Matt Heavner, Eran Hood, Cathy Connor, Rob Fatland

SEAMONSTER, the SouthEast Alaska MOonitoring Network for Science, Telecommunication, Education and Research, is a network being developed to provide infrastructure to benefit research through Southeast Alaska. The major design philosophy of modularity is used in hardware, software, communications, and every aspect of the sensor network. Sensor nodes vary in both computation power available and energy consumption rates--from some "ibutton" type sensors to low power embedded systems to powerful (and power hungry) intel x86 processor based pc104 computers are one example of the modularity. Several preliminary systems have been deployed since 2004. The first full-scale deployment of SEAMONSTER will begin in summer 2007. In this poster we will highlight the results of development and testing since 2004. The network deployed is intended to easily accomodate additional sensors from other investigators. We will describe our design for the network and solicit feedback.

65. The Effects of Variations in Canopy and Tissue Structure on Water Relations of Hylocomium Splendens along a Latitudinal Transect from Alaskan Arctic Tundra to Oregon Coastal Forest

Brian Heitz, Bjartmar Sveinbjornsson

EPSCoR Poster

66. Visualizing Glutamatergic Synaptic Transmission with Illustrative Animation

Lesa Hollen, Kelly Drew, Miho Aoki

To introduce researchers and students to glutamatergic synaptic transmission, we have derived an illustration with visualization of a glutamatergic synapse with Maya 7.0 Software. We have taken published data on protein structure, biophysics, synaptic dimensions (x,y,z), and time, to produce a fourth dimensional construct. With this illustration from animation, students and researchers are able to actually visualize NMDA receptor activation. The visualization starts from arrival of the action potential at the pre-synaptic neuron to the final opening of a NMDA receptor by removal of the magnesium ion and influx of Ca^{2+} . The unique co-agonist activation, voltage dependent block of the open ion channel, and allosteric inhibition are visualized by the viewer. Size, biophysical aspects, protein structures, and docking areas of molecules are also expressed in the animation. The size of molecular structures is maintained by use of pdb files from www.pdb.org. The fourth dimensional construct of time is set to actual data and is slowed down to correct correlated data of one nano second equaling ten frames in the Autodesk Maya 7.0 software for the human mind to be able to see and interpret. This new and exciting media conveys complex synaptic events by adding fourth dimensional constructs to two dimensional data that might derive new ideas and theories from visualization of the micro world into the macro world.

67. Growth in Subtidal Populations of the Bull Kelp, *Nereocystis Luetkeana*, in its Northern Most Range

Dominic Hondolero, Brenda Konar

Although the Bull Kelp, *Nereocystis luetkeana*, is a major canopy forming kelp in the northeast Pacific Ocean, little is known regarding its growth in the northernmost range of its distribution. Growth in three subtidal populations of *N. luetkeana* was studied in situ using SCUBA at exposed islands located in Kachemak Bay, Alaska. The specific questions asked include 1) What is the growth rate of subtidal *N. luetkeana* in Alaska 2) How does this growth rate compare to elsewhere in its range, and 3) How does stress and the reduction of photosynthetic material, induced by blade clipping, influence growth. The average growth rate observed in our study was $\sim 5\text{cm day}^{-1} \pm 2\text{ SD}$. This is a slower rate than previous studies found in intertidal populations growing at lower latitudes. Overall, individuals showed great variation in growth patterns in response to the clipping treatments. This study provides insight into growth in subtidal populations of *N. luetkeana*, where individuals can grow larger and form taller canopies, and also provides information on growth of *N. luetkeana* in conditions found at higher latitudes.

70. Biodegradation Enhancement for Soils Contaminated with Diesel or Syntroleum Fuel in a Cold Environment

Agota Horel, Silke Schiewer

The purpose of this study was to collect and analyze data on the respiration rate of naturally occurring microorganisms in hydrocarbon contaminated soils under different physical and environmental conditions. The study also includes several enhancement procedures to increase the biodegradation process under Alaskan and other cold environmental conditions.

The biodegradation rate, measured as CO₂ production, was studied as a function of time for different contaminant concentrations, temperatures, and nutrient dosages. Small scale experimental studies (32 set ups) were conducted to compare biodegradation of two types of fuels (Syntroleum versus diesel), two types of soil (gravel versus sand), two different temperatures (6° Celsius vs. 20° C), nutrient concentrations and different moisture contents.

Long term experimental data collected show that the two types of fuel have similar biodegradation rates although the synthetic Syntroleum fuel generally has somewhat higher rates than the diesel fuel. Regarding the grain size of the soil, sand had higher respiration rates than gravel, which may be due to differences in permeability and water holding capacity. The moisture content is another vital factor for the bioremediation rate; the optimum moisture content was between 4 and 10 % of the sand dry weight. Gravel has a lower water holding capacity, and therefore the water content was kept lower. Although the bioremediation process started much earlier for higher temperatures compared to lower ones, in the long run the microbes adjusted to the temperature and degraded the hydrocarbon molecules in the soil to some extent.

71. Investigating the Link Between Dimethylsulfide and Marine Wildlife Distributions: Large-Scale GIS Model of Marine Hotspots

Falk Huettmann, Clara Deal, David Atkinson

The climate-relevant trace gas dimethylsulfide (DMS) and its major biological precursor, marine algal dimethylsulfoniopropionate (DMSP), are closely linked to processes occurring at all levels of the marine food web. High amounts of DMS and DMSP are released into seawater as a result of zooplankton activities. Thus, it is very likely that regions of high primary productivity and prey aggregation can coincide with high oceanic DMS concentrations and marine wildlife abundance (e.g. as indicated by seabirds). Seabirds that prey upon zooplankton and related species possibly use their olfactory sense to cue on DMS from a wider region. A relationship between DMS and seabird abundance is almost certainly complex. One complicating factor is that DMS is only sometimes directly correlated with chlorophyll *a* concentrations, productivity or distributions of phytoplankton and zooplankton. We hypothesize that the occurrence of DMS can be spatially predicted by environmental variables using a GIS modeling approach and that the abundance of foraging seabirds should be highest in areas with high DMS concentrations. Therefore, a statistical resource preference for such locations should be found. Our study area includes Alaskan waters where many thousands of seawater DMS concentration measurements have been made in recent years (Johnson et al., unpublished data) and seabird GIS layers from the North Pacific Pelagic Seabird Database are available (USGS BRD). In order to investigate

how DMS is determined by environmental variables (e.g. SST, PAR irradiance, windspeed) a quantitative spatial model for predicting DMS concentrations is derived using statistical analyses (e.g. approaches similar to Resource Selection Function and 'Presence Only' modeling using non-linear algorithms). By overlaying the maps of modeled DMS with selected maps of seabird distribution we are investigating how resource preference of species links with DMS as a crucial marine habitat indicator. Preliminary results suggest a narrow niche for tubenose seabirds (Northern Fulmars) and a wider one for others (Least Auklets) on the DMS gradient in summer.

72. Research via Dog Sled: The 2006 Go North! Transect in Northeastern Alaska

Henry Huntington, Paul Pregont

In spring 2006, the Go North! expedition traveled by dog team through northeastern Alaska from the village of Circle through Fort Yukon, Venetie, Arctic Village, and Kaktovik, ending at Deadhorse. In the course of the trip, we interacted with local residents in a variety of ways, learning about the communities, local practices, and environmental changes, among other topics. Traveling by dog team provided us with experience in local terrain, some appreciation of spring and winter travel conditions in the region, and a connection to local practices that made conversations with local residents inevitable. In the course of our trip, we learned about drying lakes, later freeze-up, the arrival of new species, and other evidence of environmental change. Our hosts also shared lessons in winter survival and stories from trapping and other activities on the land. Our experiences on the trail and in the communities indicated how one's mode of travel can affect one's perspective.

73. Towards Comparison of Human Dimensions: Some Lessons from the Arctic

Henry Huntington, Ronald Brunner, Lawrence Hamilton, Amanda Lynch, Craig Nicolson

Human dimensions research in the Arctic examines the complex interrelationships between humans and the environment. Arctic human dimensions research to date has focused largely on specific local events and contexts and as such appears to complement more general human dimensions discussions about adaptations policies and the institutional or social context. This talk reviews five projects from the Human Dimensions of the Arctic System (HARC) initiative, established by the U.S. National Science Foundation in 1997. We extract common themes and findings (climatic variations or change affect societies through interactions with human activities, population dynamics provide key indicators of social impacts and well-being, specific impacts and responses are the result of complex interactions) and we identify common approaches to the challenges of interdisciplinary research (multivariate time plots aid the integration of data, comparative studies are essential for understanding general principles of human dimensions, arctic residents can play a vital role in research as well as action).

74. Community Perspectives on Environmental Change and the Go North! Expedition

Henry Huntington

The Go North! expedition in spring 2006 traveled through five villages: Circle, Fort Yukon, Venetie, Arctic Village, and Kaktovik. In this panel discussion, community residents will talk about their experiences with environmental change and its impacts, and also their experiences with the Go North! expedition.

75. Investigating the Dynamic Component of Sea Ice Mass Balance

Jennifer Hutchings, Cathy Geiger, Jackie Richter-Menge, Chandra Kambhamettu

There are many indications that the Arctic sea ice cover is undergoing significant climate-induced changes. Exploring why this is occurring and advancing our understanding of the role of local to regional scale processes on the sea ice mass balance could be a strong theme for the upcoming IPY.

We introduce a field campaign designed to elucidate the role of late winter ice dynamics on shaping the thickness distribution of sea ice. Our methods will include an inter-comparison of various ice thickness measurement methods, and will be used to identify optimal design for an ice mass balance observing system. We will focus our efforts on understanding the dynamical component of mass balance, and the direction and magnitude of associated feedbacks. These feedbacks may not be correctly represented in current climate models, and hence there is some possibility of

improving climate forecasts of ice retreat.

The ONR APLIS07 ice camp is planned for March/April 2006 in the Beaufort Sea. We will perform a detailed investigation of the dynamic component of sea ice mass balance at the camp. This effort is part of larger Sea Ice Mass Balance of the Arctic (SIMBA) efforts, and we will coordinate our outreach with Antarctic efforts, SIMBA-BEAR, lead by Steve Ackley, to provide a bi-polar prospective of sea ice mass balance and it's role in climate.

76. POLARities Exhibit Artist Presentation

Elizabeth Eero Irving

The artist talks about the metaphorical implications of *Phyllocnistis populiella* (Aspen leaf miner moth) larval feeding patterns and the human experience of searching, sustenance, and the ultimate goal of transformation/maturity.

77. IPY Education and Outreach: Some Thoughts on Working With K-12 Teachers

Martin Jeffries

The International Polar Year (IPY) 2007-2009 will be a period of intense, coordinated studies by multi-national teams of physical, biological, and human and social processes, interactions and feedbacks. While IPY is primarily a research activity, it is recognized that education and outreach are vital to its success. IPY education and outreach as envisioned by the U.S. National Academy can be summarized as follows: (1) develop programs that build on the inherent public interest in the polar regions and provide a broad lay audience with a deeper understanding of the polar regions; (2) create opportunities for education, training and outreach for all age groups that build on existing models, as well as involve the development of new and innovative approaches; and (3) develop the next generation of researchers, scholars, professionals and leaders, and include under-represented and minority groups. K-12 teachers can play a significant role in IPY education and outreach through partnerships with researchers. In this paper I reflect on my own experiences working with K-12 teachers, and offer some guidelines for creating and sustaining teacher-researcher partnerships for effective IPY education and outreach. Briefly put, if teachers and researchers follow the "three R's" – respect, reciprocity and responsibility – they can maximize the likelihood of achieving a rich and rewarding professional development experience.

78. The Nenana Ice Classic, Alaska: A Good Gamble for River Ice and Climate Science?

Martin Jeffries, Kim Morris

In late February/early March each year, a large, wooden tripod is erected on the ice on the Tanana River, and the top of the tripod is connected to a clock in a cabin on the riverbank at Nenana, 80 km west of Fairbanks, Alaska. The Nenana Ice Classic is then open for business; that is, for a fee, one can guess the date and time of day on that date that the clock will be stopped due to the tripod either falling over in place or being carried away with the river ice. This has been going on since 1917, when railroad construction crews, bored after a long winter waiting for the start of the construction season, decided to place bets on when the ice would break up. In this paper we examine the 89-year (1917-2006) long Nenana Ice Classic record from the perspective of river-ice break-up in central Alaska and elsewhere in the Northern Hemisphere, and whether the Tanana River break-up is a proxy for climate variation and change. The Nenana Ice Classic record reveals the following about break up on the Tanana River: (1) it now occurs 5.4 days earlier than in 1917; (2) it was relatively early during the 1940s warm interval; (3) it has become progressively earlier since the mid-1960s; (4) it has not been affected by the Pacific Decadal Oscillation, including the 1970s shift, or the Arctic Oscillation; and (5) it is strongly correlated with Arctic air temperature. We speculate that break-up on the Tanana River would respond quickly to a 2-5 year cooling period and the onset of later break-up would become evident within that time frame. In conclusion, the Nenana Ice Classic record of break-up on the Tanana River is a good proxy for climate variation and change.

79. Involving Northern Students in Research: Examples in Archaeology and Ethnography

Anne Jensen

This paper describes two projects, which involve Northern students in archaeological and ethnographic research. One of these is entering its third year in the present form, while the other is still under development, with students taking an

active part in that development.

The ECHO Nuvuk project is involving students in all phases of a major archaeological project to excavate threatened cultural resources, and save the data they contain about the past 1100 or 1200 years of history at Nuvuk. Results to date include a series of burials dating to 900-1200AD as well as a well-preserved post-contact activity area from a stratified peat which included faunal material ranging from bowhead whale to pig. Additional research projects have developed in connection with this excavation, including skeletal morphometrics, ancient human DNA, a specialist analysis of wood and woodworking, and geophysical site mapping.

The second project is based on John Murdoch's Ethnological Results of the Point Barrow Expedition (1892) and Turner's Ethnology of the Ungava District (1894), encyclopedic ethnological reports which are perhaps the most lasting product of the scientific output from the 1st IPY. We will be undertaking a modern version of these ethnological collecting projects. The project will document modern equivalents of the items they collected and their uses. Project documentation will provide a valuable resource for comparative studies of Iñupiat material culture change through time. A K-12 educational component involving partnerships between Northern and southern schools has also developed in connection with this project.

80. Development of Coupled Ice-Ocean Ecosystem and Application to the Ice-Core Data in Land Fast Ice Offshore Barrow

Meibing Jin, Clara Deal, Jia Wang

Based on biophysical ice core data collected in the landfast ice off Barrow in 2002 and 2003, a 1-D ice-ocean ecosystem model was developed to determine the factors controlling the bottom ice algal community. The oceanic ecosystem submodel has been successfully applied the NOAA/PMEL mooring 2 in the southeastern Bering Sea, and was coupled with the new sea ice ecosystem submodel by the transport through water-ice interface. The data and model results revealed a three-stage ice algal bloom: 1) onset and early slow growth stage before middle March, when growth is limited by light; 2) fast growth stage with increased light and sufficient nutrients; 3) decline stage after late May as ice algae are flushed out of the ice bottom. The stages 2 and 3 are either separated by a transition period as in 2002 or directly connected by ice melting as in 2003 when in situ light and nutrient enrichment experiments showed only light limitations. The modeled net primary production of ice algae (NPPAi) from March to June are 1.2 and 1.7g C/m² for 2002 and 2003, respectively, within the range of previous observations. Model sensitivity studies found that overall NPPAi increased almost proportionally to the initial nutrient concentrations in the water column. A phytoplankton bloom (if it occurs like in 2002) would compete with ice algae for nutrients and lead to reduced NPPAi. About 45% of the NPPAi was exported to the shallow benthos. Our future plan is to apply the coupled ice-ocean model to the Bering Sea shelf.

81. MK-801 Induces Arousal in Hibernating Arctic Ground Squirrels

Tulasi Jinka, Kelly Drew

Arctic ground squirrels (AGS; *Spermophilus parryii*), hibernate to endure long periods of extreme cold and scarce food availability. Hibernation is a poorly understood process, characterized by regular periods of low metabolic activity (torpor) interrupted at regular intervals by arousal where metabolic activity returns to normal, euthermic levels. N-methyl-D-aspartic acid (NMDA) type glutamate receptors are thought to play a role in hibernation and respiratory control and glutamate may play a regulatory role in maintenance of torpor. This hypothesis is supported by a study in hibernating Golden-mantled ground squirrels (*Spermophilus lateralis*), where administration of MK-801 (5 mg/kg, ip), a non-competitive NMDA antagonist induced arousal (Harris and Milsom, 2000). It has been suggested that release of the excitatory neurotransmitter glutamate allows for entrance and maintenance of torpor and that arousal is facilitated by a decrease in glutamate release. The purpose of the present study was to test the hypothesis that NMDA receptors (NMDAR) play a role in maintenance of torpor in AGS. Saline or MK-801 (5 mg/kg, ip) was administered on the 4th day of a torpor bout in a volume of 1mL/kg. Arousal was quantified from respiratory rate (breaths per minute, bpm) and from an arousal index based on a nominal scale of 0 to 6 where 0 was deep torpor indicated by a respiratory rate of less than 5 bpm and 6 was a fully active animal. Results showed that MK-801 induced arousal in all AGS tested ($p < 0.05$, $n = 3$ AGS) while saline injections did not evoke a statistically significant increase in respiratory rate or arousal index ($n = 3$ AGS). These results are consistent with the hypothesis that hibernation is facilitated by NMDAR activation and that removal of NMDAR activation results in arousal. These results further replicate evidence for MK-801- induced

arousal observed previously in a different species (Harris and Milsom, 2000). The high dose of MK-801 needed to induce arousal may be due to low blood flow and consequently poor absorption and distribution of drug following an ip injection in hibernating animals. Follow-up studies are planned to administer MK-801 into the lateral ventricle to test the hypothesis that arousal is induced via activation of central NMDAR and to determine the dose-response relationship of MK-801-induced arousal following intracerebroventricular administration.

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Harris MB and Milsom WK, 2000, Is hibernation facilitated by an inhibition of arousal? In *Life in the Cold* (G. Heldmaier and M Klingenspor; Eds.) Springer-Verlag Berlin, pp241-250.

82. Place-Based Adult Science Education Program Development in Denali National Park, Alaska (Phase 2)

Shann Jones

This poster session reviews the concept, design, and fruition of a place-based adult science education workshop piloted in 2005 at the Murie Science and Learning Center, Denali National Park and Preserve, Alaska in 2005 and refined at the same site in 2006.

Although the benefits of physical activity across the life span are well documented, related research clearly indicates that adults also desire to grow intellectually even long after their school days are over. This desire has been manifested through the demonstrated growth in post-secondary weekend education workshops throughout North America.

In this case study the author documents 20 adults' weekends at two Alaska Natural History Institute's Field Seminars exploring the vast ecosystem of Interior Alaska while their University of Alaska instructor uses the angler/aquatic education as the presentation medium to teach various scientific concepts. At the start of both workshops, each participant filled out a questionnaire which gauged their knowledge of scientific concepts and angling experience. Throughout both weekends, discussions were held to help members of the group express their newly found knowledge in the arenas of biology, ecology and physics. Also students were given ample opportunity to practice and demonstrate new physical skills. The author documents that group made measurable increases in their understanding of biological, chemical and physical science concepts over the span of this 20-hour workshop. Moreover, individual participants showed that they were able to apply their newfound knowledge either by enhancing personal skills or, in the cases of the K-12 teachers in attendance, by developing grade-specific activities for their schools.

This presentation also emphasizes how cost-effective modern science-based experiential education program development is achievable through teamwork and collaboration between diverse agencies, each with different missions.

83. Glacier Mass-Balance Fluctuations in the Pacific Northwest and Alaska, USA

Edward Josberger, William Bidlake, Rod March, Ben Kennedy

The mass balance of mid-latitude glaciers of the Pacific Northwest and southern Alaska fluctuates in response to changes in regional and global atmospheric climate. More than 40 years of net and seasonal mass balance records by the U.S. Geological Survey for South Cascade Glacier, Washington, and Wolverine and Gulkana Glaciers, Alaska, show a variety of annual and inter-annual fluctuations that reflect the controlling climatic conditions. The first two glaciers are strongly affected by the warm and wet maritime climate of the Northeast Pacific Ocean, and the winter balances are strongly related to the Pacific Decadal Oscillations (PDO), and to El-Nino-Southern Oscillation Index (ENSO) events. Gulkana Glacier is more isolated from maritime influences and net balance variation is more closely linked to the summer balance. By the late 1970s, mass-balance records for the three glaciers were long enough to reflect the 1976-77 shift in the PDO from negative to positive. Both maritime glaciers responded, with net balance of South Cascade Glacier becoming consistently negative and that of Wolverine Glacier becoming predominantly positive. The overall trend of negative mass balance continued through 2004 for South Cascade Glacier, where the cumulative net balance during 1977 to 2004 was about -22 meters water equivalent (mweq). After a gain of about 7 mweq, the trend of positive net balance for Wolverine Glacier ceased in 1988. After 1988, net balance of Wolverine Glacier became predominantly negative and the cumulative net balance for 1989 to 2004 was about -14 mweq. Net balance of Gulkana Glacier did not respond appreciably to the 1976-77 PDO shift. The cumulative net balance of Gulkana Glacier from the beginning

of the record (1966) and through 1988 was about -3 mweq. The major change of trend in mass balance for Gulkana Glacier occurred in 1989, when net balance became almost exclusively negative. The cumulative net balance during 1989 through 2004 was about 13 mweq. As a result, by 2004, trends in net balance had been strongly negative for more than a decade at all three benchmark glaciers.

84. Vertical Flux of Particulate Organic Material on the Mackenzie Shelf (Western Canadian Arctic) during Fall 2002

Thomas Juul-Pedersen, Christine Michel, Michel Gosselin, Bernard LeBlanc

The vertical sinking fluxes of organic and inorganic particulate material were studied on the Mackenzie Shelf, Western Canadian Arctic, during the Canadian Arctic Shelf Exchange Study (CASES). The amount and composition of the sinking particulate material were assessed at 6 stations on the Mackenzie Shelf from 24 September to 10 October 2002. At each station, free-drifting particle interceptor traps were deployed at 8 depths ranging from 10 to 150 m during ca. 24 h. The collected particulate material was analysed for total pigment, chlorophyll a (total and >5 µm), particulate organic and inorganic carbon (POC and PIC). A transect, comprised of 3 stations, perpendicular to the coastline showed varying degrees of influence from the Mackenzie River. Comparing results along this transect showed that a high amount of non-pigmented particulate organic carbon was exported by the river, resulting in decreasing POC fluxes (from 249 to 11 mg/m²/d) and decreasing POC/total pigment ratios (from 430 to 203 g/g) with increasing distance from the river outlet. The sinking algal material on the Mackenzie Shelf was dominated by larger cells, as shown by a strong correlation between total chlorophyll a and chlorophyll a >5 µm (slope = 1 g/g, r² = 0.95). These results show that the Mackenzie River strongly influences the amount and composition of the sinking material on the inner shelf area.

85. Structure and Properties of Basal Ice and Subglacial Moraine

Mikhail Kanevskiy, Vladimir Tumskey, Daniel Fortier, Torre Jorgenson, Yuri Shur

The structure of basal ice and subglacial moraine was studied at two large valley glaciers: Matanuska Glacier (Chugach Mountains, South-Central Alaska) and Muldrow Glacier (Alaska Range). The researches included descriptions of natural exposures, estimation of ice content of glacial sediments, study of crystal structure of various kinds of ice.

We consider basal ice as mainly glacial ice alternated at the basal zone of the glaciers; this ice contains relatively big amount of moraine material. The subglacial moraine consists mostly of frozen soil with segregated ice. Our studies show that the boundary between basal ice and subglacial moraine in many cases cannot be defined clearly.

The subglacial moraine at the terminal zone of Matanuska Glacier is composed by coarse-grained sediments cemented mostly with sand and silt. The visible thickness of sediments in studied sections reaches 4 m. The subglacial moraine is characterized by prevailing of lenticular and ataxitic cryogenic structures. The sediments have frequent interbedding of ice lenses and thin soil layers with various types of cryogenic structure and different ice content. The ice content of sediments decreases with depth. Usually the gravimetric moisture content at the upper parts of the sections (basal ice) reaches 150-300% while in the lower horizons (subglacial moraine) its values do not exceed 40-50%. The amount of ice-rich layers (or ice lenses) in the sections of subglacial moraine usually does not depend on the ice content of the sediments and varies from 10 to 15 per each 10 cm of section. We believe that such type of cryogenic structure developed in the conditions of epigenetic freezing at the terminal zone of glaciers. The main lenses of ice were formed in the parallel fractures originated from the different velocities of movement of the layers at the basal zone of glaciers.

The upper boundary of subglacial moraine can be distinguished by occurrence of fold deformations and sufficient increase in thickness of ice lenses. The overlying layer of stratified basal ice differs from englacial ice by dark color, small amount of air bubbles, transparency, and numerous folded layers of moraine material. A thickness of the basal ice in studied sections reaches 1-1.5 m, but in the other sections at Matanuska Glacier it reaches 15 m. Folds in basal ice often correlate with dislocations in overlying englacial ice. The basal ice at the terminal zone of Muldrow Glacier has different structure. Its thickness reaches 12 m. This dark-colored transparent ice with mainly horizontal stratification distinguished by layers of moraine material. Exposures of the subglacial moraine at Muldrow Glacier were not found.

The study of glacial ice buried in terminal moraines shows that these ice bodies are represented mainly by the basal ice with different degree of deformation. The moraine material thawing from the ice produces the shielding layer at the surface, which prevents further thawing. Therefore basal ice has greater probability to exist in buried state than

englacial ice with low amount of moraine material. The study of structure, formation and burial of basal ice is very significant because it can help to solve the problem of origin of massive ground ice bodies, and to estimate the intensity of thermokarst processes connected with global warming.

The work was supported by the National Science Foundation EPS-0346770 and ARC-0454939. Any opinion and findings expressed in this material are those of the authors and do not necessarily reflect the views of the NSF.

86. Mercury in Ancient Hair from a Chilean Mummy

Michelle Kaye, Joel Irish, Bernardo Arriaza, Lawrence Duffy

Hair analysis has become a routine tool for both forensic and clinical screening of metal exposure in the human body. Systemic intoxication is recognized by anomalously high values of Hg. As the modern data base for Hg increases, the question of the extent of changes in Hg exposure from preindustrial to modern times has been raised for pan-Pacific peoples. Hair is sometimes preserved over centuries and has been useful in determining the extent of dietary mercury exposure. We examined a human hair sample taken from the remains of a northern Chilean Chinchorro mummy identified as Morro 1, T28 C. 24. The hair sample was analyzed by cold vapor atomic fluorescence spectrometry. The analysis was run using standard reference material by Frontier Geosciences (Seattle, WA). The total mercury concentration (THg) was 0.315 ppm. While this THg level is lower than the mean level of mummies from the Karluck archaeological site in Kodiak, AK (1.33 ppm) and Barrow, AK (3 ppm), it falls within the range of samples analyzed (0.12 – 3.22 ppm). Because hair would have been subjected to a variety of environmental influences over hundreds of years, the data must be interpreted cautiously; however, this sample fits the pattern of similar exposure over time to Pacific peoples. (Supported in part by NSF-OCE 0525275)

87. Mitigation of Air Pollution in the Arctic and Subarctic Regions Using Nanofluids to Heat Buildings

Devdatta Kulkarni, Praveen Namburu, Debendra Das

Many recent studies have shown that nanofluids, with metallic nanoparticles as suspension, increase the thermal conductivity of base fluid by a substantial amount. Research on copper oxide nanoparticles in water has revealed that a 60% increase in the thermal conductivity can be achieved at a particle concentration of 5 % by volume. A 60 % increase in the convective heat transfer coefficient can be achieved in copper oxide-water nanofluid at a particle concentration of only 2 % by volume. The building heating cost in Alaska and similar circumpolar regions are high and the escalating cost of fuel has made it urgent to look for ways to reduce the fuel consumption in heating buildings. In our presentation, we will describe the experiments performed on nanofluids at the University of Alaska Fairbanks laboratory, showing the enhancement of heat transfer characteristics. Calculations have been carried out for a building in Fairbanks, Alaska showing that application of nanofluids could result in fuel savings. Nanofluids also require smaller heating systems capable of delivering the same amount of thermal energy, thus reducing the initial cost of equipment. In our presentation we will present the reduction of CO₂ and NO_x emissions due to the reduction in fuel consumption in a household furnace, thereby reducing the indirect impact of global warming, which is felt most severely in the arctic region.

88. 1-D Numerical Analysis to Predict a Buried Chilled Gas Pipeline

Koui Kim, Wendy Zhou, Scott Huang

EPSCoR Poster

89. Potential Effect of Boreal Wildfire Soot on Arctic Sea Ice and Alaska Glaciers

Yongwon Kim, Hiroshi Hatsushika, Reginald Muskett, Koji Yamazaki

The role of black carbon (BC) soot in the Arctic as an agent of climate warming through forcing/feedback of sea ice/ glacier albedo is an uncertainty in need of addressing. In-situ measurements of BC-aerosols and gas byproducts from the FROSTFIRE experiment burn, 8-11 July 1999, are used with a coupled high-resolution wind field/empirical fall-out model to assess transport/dispersion and estimate deposition. Results suggest that BC-aerosols (soot) are quickly

transported from central Alaska to the Arctic Ocean region of multi-year sea ice and to southern Alaska glaciers, where up to 20% can be deposited. The estimate of BC soot concentration from Alaska boreal wildfires favorably compares to in-situ sea-ice observations made in 1998 and snow albedo observation on Gulkana Glacier in 2001. We hypothesize that northern boreal wildfires are a possible contributor in the reduction of first/multi-year sea ice/glacier extent by enhancing summer melting from albedo reduction. Should the occurrence and severity of northern boreal wildfires continue as expected in summer 2004, more than 670 km² burned as the worst wildfire year on record, there will be implications for climate warming.

90. Winter Fluxes of CO₂ and CH₄ in Boreal Forest Soils of Central Alaska Estimated by the Profile Method and the Chamber Method: An Implications for the Regional Carbon Budget

Yongwon Kim, Masahito Ueyama, Fumiko Nakagawa, Urumu Tsunogai, Yoshinobu Harazono, Noriyuki Tanaka

This research was carried out to estimate the winter fluxes of CO₂ and CH₄ using the concentration profile method and the chamber method in black spruce forest soils in central Alaska during the winter of 2004/5. The average winter fluxes of CO₂ and CH₄ by chamber and profile methods were 0.24±0.06 (SE; standard error) and 0.21±0.06 gCO₂-C/m²/d, and 21.4±5.6 and 21.4±14 µgCH₄-C/m²/h. This suggests that the fluxes estimated by the two methods are not significantly different based on a one-way ANOVA with a 95% confidence level. The hypothesis on the processes of CH₄ transport/production/emission in underlying snow-covered boreal forest soils is proven by the pressure differences between in air and in soil at 30 cm depth. The winter CO₂ emission corresponds to 23% of the annual CO₂ emitted from Alaska black spruce forest soils, which resulted in the sum of mainly root respiration and microbial respiration during the winter based on the 13CO₂ of -22.5. The average wintertime emissions of CO₂ and CH₄ were 49±13 gCO₂-C/m²/season and 0.11±0.07 gCH₄-C/m²/season, respectively. This implies that winter emissions of CO₂ and CH₄ are an important part of the annual carbon budget in seasonally snow-covered terrain of typical boreal forest soils.

91. Lichens Respond Differently than Vascular Plants to Climate Warming on a Bering Sea Island

David Klein, Martha Shulski

Lichen-dominated plant communities on St. Matthew Island in the northern Bering Sea were markedly altered by grazing pressure following introduction of reindeer. By 1963, the 29 reindeer released in 1944 had increased to 6,000. Lichens, the primary winter food of the reindeer, had been virtually eliminated in the previously lichen-dominated plant communities on the island. During late January and early February of 1964, an anomalous weather event of extreme cold and heavy snow fall resulted in a massive and near total die off of the reindeer. At the peak of the reindeer population in the summer of 1963, those plant communities that had been lichen-dominated prior to the introduction of reindeer had become dominated by vascular plants, mainly sedges (*Carex* spp.) and willows (*Salix arctica*). In addition to the lichens consumed by the reindeer, large amounts of lichens fragmented through trampling and the grazing process were blown to sea by the strong winds characteristic of the island, leaving virtually no live lichen tissue on the ground surface for regeneration. When the island was re-visited in 1985, little lichen recovery had occurred in the 22 years following the reindeer die-off. In vegetation plots established on St. Matthew Island in 1957, re-growth of lichen biomass, primarily by "pioneering" species, accounted for less than 10% of lichen biomass in similar plant communities on adjacent and un-grazed Hall Island. At the Hall Island location the "climax" lichen species (*Cladina* spp. and *Cetraria* spp.), favored by reindeer and caribou as winter forage, predominated in the thick lichen mats. When the vegetation plots on St. Matthew Island were again examined in 2005, 42 years after the reindeer die-off, we were surprised to find no significant changes in lichen biomass. A drying trend was indicated by a pronounced decrease in lake levels with grasses and other vegetation invading the exposed lake bottoms. Analysis of weather records from St. Paul Island, 400 km southeast of St. Matthew Island and the closest available station with long-term data, document a warming trend in the northern Bering Sea since 1950, most pronounced since the late 1970's. Reduction in the extent of winter sea ice in the northern Bering Sea in recent decades has also been associated with global climate warming. The St. Paul weather data shows a decrease in summer precipitation and relative humidity since 1950. Thus, climate warming in recent decades in the northern Bering Sea and associated summer drying have been primary factors responsible for greatly reducing favorability for lichen growth on St. Matthew Island and slowing recovery of lichens from the over-grazing in the past by reindeer. The pronounced warming in much of the Arctic and Sub-arctic in recent decades has favored growth of many vascular plant species in tundra plant communities. It is now evident, however, that lichens, a unique symbiotic relationship of fungal and algal components, are responding differently than vascular plants to climate warming.

92. Starting the Clock for the CircumArctic Rangifer Monitoring and Assessment Network

Gary Kofinas, Wendy Nixon

Over 4 million wild caribou and reindeer (*Rangifer tarandus*) inhabit the earth's arctic regions. These animals provide an economic and cultural mainstay for arctic indigenous peoples. Recently, profound changes have occurred in the north relating to climate and increasing human activity. These changes may jeopardize the relationship between Rangifer, the land and the people. The CARMA (CircumArctic Rangifer Monitoring and Assessment) Network was established in 2004, with representation from co-management boards and from social, biological, animal health, habitat and meteorological sciences. The mission of CARMA is to monitor and assess the impacts of global change on the human-Rangifer system across the circumarctic through cooperation, both geographically and across disciplines. The CARMA Network will address the need for an intensive, coordinated, multi-scale, multi-disciplinary monitoring program. Over the next five years, the Network will: (1) address specific research questions, (2) involve northern communities, (3) provide valuable baseline data for reference herds, and 4) assess the resilience of regional human-Rangifer systems. The assessment will focus on the health and status of Rangifer, and habitat and community responses to change. Three sub-groups will focus on: (i) biological, (ii) community and (iii) habitat (using remote sensing) monitoring. These sub-groups will work with co-management boards to develop tools to assess and plan for vulnerabilities in the arctic human – Rangifer system. This program will build the capacity of local communities that rely on Rangifer, as well as co-management boards and managers, to respond proactively to change.

93. Endophytic Fungi - Grass - Herbivore Interactions in Northern Ecosystems

Saewon Koh, David Hik

Endophytic fungi are plant symbionts living asymptotically within plant tissues. *Neotyphodium* spp., asexual vertically transmitted systemic fungal endophytes of cool season grasses, are predicted to be plant mutualists. These endophytes increase the competitiveness of the host plant by increasing resistance to environmental stresses and/or increasing the production of alkaloid-based herbivore deterrents. However, the ubiquity of this defense mutualism is unclear with a variety of alternative control mechanisms to potentially explain the variation in infection rates, levels of deterrence and thus the maintenance of asexual endophytes in grass populations. We have found that grass-endophyte interactions are variable and ordered along a herbivory gradient in an undisturbed subarctic alpine ecosystem (Ruby Range Mountains, southwest Yukon, 61° N, 138° W, elevation 1900 m). Native grass populations (*Festuca altaica*) in grazed sites had significantly greater rates of endophytic infection compared to ungrazed sites.

The ability of grass-endophyte constituents to deter herbivory outside of agronomic systems is untested, but thought to be rare. We found that within grazed meadows, endophyte infection resulted in the deterrence of grazing by native vertebrate herbivores. However, the same herbivores did not distinguish between infected and uninfected grass harvested from ungrazed areas. These novel results support the hypothesis that the grass-endophyte relationship (in an alpine setting above the treeline) is primarily a defense mutualism and controlled by varying levels of herbivory (top-down).

Using similar methods, we determined endophyte infection frequency of *Festuca altaica* within a 17-year herbivore exclusion- fertilization (2 x 2 factorial design) experiment in the understorey of a boreal forest 30 km from the alpine site. At the lower elevation site (900 m) it appears that infection rates were controlled by the intensity of competition as a function of fertilization (bottom- up control). The broader implications for control of community dynamics under rapid warming will be discussed.

94. POPs Convention: Implications for Science and Policy

Pia Kohler

The Stockholm Convention on Persistent Organic Pollutants (POPs) is one of the newest additions to the MEA landscape. This paper will discuss the science and policy implications of the work of the Convention's science advisory body, the POPs Review Committee (POPRC), and will draw from models of science-policy interaction in other multilateral environmental agreements (MEA).

95. An Introduction to Results and Applications of the Survey of Living Conditions in the Arctic

Jack Kruse

The intent of the Survey of Living Conditions in the Arctic (SLICA) is to measure living conditions in a way that is relevant to Native people in the Arctic. The purpose of measuring living conditions is to better understand the Native peoples of the Arctic and the effects of policies and global changes on living conditions. Communities as well as regional, national, and international organizations will be able to use the data to inform their own decisions. Researchers will use the data to investigate ideas about change in the Arctic.

This presentation describes the SLICA data set and provides a sample of results for Alaska, Canada, Greenland, and Chukotka. The presentation also illustrates the data set's analysis potential using one of the international analysis themes. For more information, please visit the project website, www.arcticlivingconditions.org

96. Improved Water Management in Homes Without Running Water: Recommendations for Chlorine Dosage, Water Storage, and Hand Washing

Shawna Laderach, Silke Schiewer, Daniel White, David Barnes

The objective of this study was to investigate and make recommendations for improved in-home water management in an underserved rural Alaskan community without piped water. The main focus of the study is point-of-use disinfection. Point-of-use disinfection using sodium hypochlorite solution has been successfully implemented by the Centers for Disease Control and Prevention (CDC) in many third world areas as an interim means of providing safe water. After the water is disinfected, proper storage and handling are still important to prevent recontamination; therefore, storage and hand cleaning were explored as supplementary sanitation measures.

After dosing different initial amounts of chlorine to different water types, the chlorine decay for each of these cases was monitored over a period of several days. A model was developed to predict the chlorine decay over time and the necessary chlorine dosage for water used in the pilot community so that sufficient residual chlorine would remain during storage. Storage temperature, TOC concentration, and concentration of reduced iron were determined to be important factors influencing the residual detention time. Safe chlorination levels of between 0.2 mg/L and 4.0 mg/L as recommended by the Alaska Department of Environmental Conservation (ADEC) could be achieved in a reasonable time, and safe residual levels could be maintained for typical storage times. A taste test in the community showed that levels below 0.3 mg/L were acceptable for drinking without any chlorine taste.

Storage and handwashing are likely major components of preventing microbial contamination. Safe storage containers with small openings and a spigot or spout to prevent the potential and need for dipping are recommended. It was determined that closed containers do not slow the loss of disinfectant from evaporation. Hand washing in basins with standing water was shown to be less efficient in removing coliforms than hand washing using running water. Alcohol gels are effective; however, they may be too expensive for users. Therefore, an electric hand washing station or hand washing using a spigot is recommended. Thorough handwashing for at least one minute using soap and running water is recommended, since this was the most effective method to remove coliform bacteria from hands. To gain community acceptance of the recommended practices, it is recommended to introduce them in the clinic and school by making literature available and implementing the methods/devices there.

97. Comparison of Characteristics of Bottom Sea Ice Algae at Different Regions for Their Ecological Significance

Sang Lee, Terry Whitlege

The different characteristics of inorganic nutrients in the water column and sea ice, chlorophyll-a concentrations, and carbon and nitrogen uptake rates of ice algae and phytoplankton were compared between the land fast-sea ice at Barrow as a coastal condition and the first-year sea ice at the ICES site as a oceanic condition during the same period (early April) in 2003. The results showed three ecological implications for bottom ice algae in the Arctic Ocean: 1) Different nutrient reservoirs within sea ice and in the surface water column below the sea ice at different locations might control maximum biomass of bottom ice algae and thus the relative contribution of ice algae production, 2) different initial biomass of bottom ice algae might change the timing of bloom, 3) the fate of the ice algae at the bottom of sea ice might be different among the various geographic areas depending on their size composition, especially between

coastal and oceanic environments. The specific characteristics of bottom sea ice algae at different locations, especially for coastal and oceanic environments, should be carefully considered in the future ice-ocean biogeochemical modeling in the Arctic Ocean.

98. Ontogeny of Muscle Development in Harp and Hooded Seals: Implications for the Phocid Terrestrial Postweaning Fast

Keri Lestyk, Jennifer Burns, Mike Hammill, Arnoldus Blix, Lars Folkow

Pinniped neonates are essentially terrestrial at birth, however, once weaned have an entirely marine prey source. Yet, newly weaned pups endure a terrestrial postweaning fast where mass and condition are lost before foraging begins. While the purpose of this fast remains unclear, it may provide time for blood and muscle oxygen stores to mature. To investigate patterns of muscle development in shallow and deep diving phocids, muscle samples from 23 harp (*Phoca groenlandica*) seals (9 neonates, 5 weaned pups, and 9 adult females, maximum dive depth 370m) and 38 hooded (*Cystophora cristata*) seals (7 neonates, 17 weaned pups, and 14 adult females, maximum dive depth >1,000m) were collected in Norway (1999 and 2000) and Canada (2005). Myoglobin concentration ([Mb]) was measured in ten muscles from across the body. Adult [Mb] ranged from 13.3 - 103.3 mg·g⁻¹ wet mass muscle and 23.9 - 108.5 mg·g⁻¹ wet mass muscle in harp and hooded seals respectively, with values increasing from the sternothyroideus muscle in the cervical region to the longissimus dorsi muscle in the lumbar region. In addition, adult [Mb] was 3-4 times higher in swimming vs. non-swimming muscles. In neonates and weaned pups, [Mb] for all muscles was significantly lower than in adults and there was little difference in [Mb] between swimming and non-swimming muscles. For all age classes, [Mb] in the commonly sampled longissimus dorsi was up to 30% higher than the total body average, indicating that sampling sites must be considered carefully prior to extrapolating values from one muscle to the entire body. In addition, acid buffering ability, aerobic (citrate synthase and β -hydroxyacyl coA dehydrogenase) enzyme and anaerobic (lactate dehydrogenase) enzyme profiles indicate that pup muscles have a lower anaerobic capacity than adult muscles. These results suggest that little development occurs during the nursing period and that physiological mechanisms regulating muscle development may influence the necessity and duration of the postweaning fast.

99. Investigation on the Long-Range Impact of Alaska Land-Cover Changes using Similarity Analysis

Zhao Li, Nicole Mölders

In high-latitudes, land-cover changes caused by wildfires or increased agricultural use cannot only alter regional evapotranspiration, precipitation and runoff, but also modify the interaction between the global and regional water cycles. Thus, the land-cover changes may affect neighboring areas by atmospheric transport of modified air mass. Two 40-year simulations performed with the fully coupled Community Climate System Model (CCSM) with current and altered land-cover in Interior Alaska are analyzed using similarity coefficients to examine the long-range impact of these land-cover changes on climate. The result shows that the land-cover changes lead to increased evapotranspiration in June and July. Precipitation decreases from late summer to early fall due to decreased large-scale transport. Weaker interaction between the regional and global water cycle is found in most months with decreased monthly moisture fluxes into and out of Alaska as a consequence of the land-cover changes. The similarity analysis shows that the impact of the land-cover changes is smallest during summer and the radius of influence is smallest during winter, while during onset of snow coverage and snowmelt the impact is greatest and the farthest reaching outside the region (similarity coefficient less than 0.9 for mid-latitude). This suggests that the land-cover changes in high latitude are most pronounced and likely to cause significant impact outside Alaska during the transient seasons.

100. Physical Short-Term Changes Following a Fire at a Tussock Tundra Site, Seward Peninsula

Anna Liljedahl, Larry Hinzman, Robert Busey

The Kougark area, situated on the central Seward Peninsula, Alaska, experienced a severe tundra wildfire in August 2002. Soil and meteorological observations have been made in this area since 1999 until present at a fixed location with vegetation mainly consisting of *Eriophorum* tussocks. This is perhaps the only tundra fire where high-quality pre-fire and post-fire soil and meteorology measurements have been collected in the same location. During this time period, the annual average soil temperatures increased throughout the entire soil profile (1m) $1.5 \pm 0.3^\circ\text{C}$ after the first

year (2003) and an additional 1.1°C in the following two years. However, that soil warming is not only a result of the fire. An adjacent area that was not burned 2002, also show higher soil temperatures but to a lower magnitude, indicating that in general, the post-fire weather has favored warmer ground conditions. Post-fire years experience a longer thaw period through an earlier snowmelt and a significantly delayed post-fire freeze-back. The two to four week earlier snow ablation in a time period of high incoming short wave radiation, results in a noticeable thermal advantage of the soil, due to a drastically reduced albedo of the snow free, recently burned surface.

The near surface soil displayed increased post-fire moisture levels at the burned site that remained close to saturation throughout the thaw season; a phenomenon still present in the summer of 2005. This clear pre- and post-fire separation of the soil water content after spring melt can not be seen at the control site. The increased soil moisture following fire is due to the lack of vegetation, but also due to the fact that the probes were re-installed into a different soil type although the distance from the surface remains the same. After the fire, ~7cm of the organic soil remained of the previous 15cm porous layer. The mineral content of the post-fire soil at that depth limits soil water fluctuations.

The fire effects combined with silty, ice-rich, and warm permafrost lead to drastic thermal and mechanical erosion of the Niagara Creek (6.5km²) streambed, which resulted in a >3500m³ gully. The end of the gully shifted 12m further upstream during a 6-week period in the first half of summer 2005, with a continuous widening initiated by thermokarsting.

While increasing trends in annual area burned are found in boreal Canada and Alaska, the fire record of Seward Peninsula, which is mainly represented by open tundra, indicates a slightly downward trend during the last 50 years for fires larger than two hectares. Seward Peninsula, like the boreal region, displays large variations between the years concerning the annual area burned. Since previous studies suggests that a warmer climate in the Arctic region strongly influences the areal extent and severity of fires, this study contributes to a better understanding of the changes in arctic open tundra biotic and abiotic regimes that are directly or indirectly induced by a changed climate.

101. UAF Science Education Outreach Network: Making Connections during the International Polar Year

Becky Lindsey

The UAF Science Education Outreach Network (<http://www.scienceoutreach.uaf.edu>) is an innovative new resource for researchers, educators, students and community members in Alaska. The Network is a database-driven Web site developed to provide information about the wide variety of science education outreach programs and resources (tours, public lectures, science competitions, curricula and lessons) available at UAF and its extended campuses. The Network is the first of its kind at UAF. Prior to its development, science education outreach efforts occurred independently of each other. Because no overall list of activities existed, little coordination among departments occurred and public information about the breadth and diversity of science education outreach available at UAF was virtually inaccessible.

A searchable database, the UAF Science Education Outreach Network (SEON) represents a campus-wide effort to make information about science education outreach available to K-12 students and teachers, UAF college students, and community members across the state. Outreach programs and opportunities at UAF can be viewed on the Network by science discipline, activity, Alaska region, and Alaska Native culture, as well as by audience and calendar date. We added a new category that highlights the education outreach programs associated with International Polar Year.

With over 6,000 Web hits per month, resulting in over 20,000 program searches, SEON is proving to be a valuable resource for Alaskans. Teachers and community members statewide refer to the Web site year-round to find UAF science programs and events taking place in their region.

Scientists conducting research during IPY can use the Network to make connections with Arctic communities. IPY programs that include an education outreach component can be posted directly to the Network. In addition, the Network can help researchers that do not have a formalized outreach component by providing a way to connect with communities, teachers and students. Scientists can use the Network to make information about their research available to the public; provide information on research schedules that may allow the opportunity for community or classroom presentations; provide links to data and resources that can be incorporated into community or classroom discussions.

In this presentation, Network Coordinator Becky Lindsey will discuss the functions of the UAF Science Education Outreach Network and how it can help IPY researchers communicate their science to a variety of audiences throughout

Alaska.

102. Post-fire Landscape Heterogeneity in the Boreal Forest: Implications for Moose Winter Foraging Habitat

Rachel Lord, Knut Kielland

The fire regime in interior Alaska is linked with moose (*Alces alces*) populations insofar as fire initiates secondary succession that may provide increased winter forage for moose. Burns that are 11-30 years old are considered, on a coarse scale, to be preferentially utilized by moose during the winter months. Depending on fire severity and other landscape characteristics, the spatial heterogeneity following fires over the boreal landscape may exert long-term influence on the quantity and quality of moose wintering habitat on finer spatial scales within burn scars in interior Alaska. This research focuses on the current forage distribution and moose utilization patterns within the Rosie Creek Burn (appx. 35 km² which burned in 1983 and is part of BNZ LTER, 40 km SW of Fairbanks, AK USA) through the use of remote sensing, GIS, and ground-based field data. Our primary question is: Within a burn unit that is 11-30 years old, do moose preferentially utilize areas of high burn severity? Increasing fire severity within the boreal forest is generally associated with decreased soil organic matter depth and a higher production of preferred forage species such as willow (*Salix* spp.) and aspen (*Populus tremuloides*). To address this question, 84 systematic browse survey plots were set up during March 2006 within the Rosie Creek Burn. Within each plot, measurements were taken in concordance with the Alaska Department of Fish & Game browse survey to estimate biomass of current-annual-growth and removal by moose during the 2005-06 winter. Soil organic matter depths and vegetation stem count measurements were taken at an additional 60 transects in June (2006) to assess fire severity in conjunction with Landsat TM scenes from August 1985. Preliminary results show that across the entire burn, relative biomass removal (ratio of consumption : availability) by moose is greater from willow, followed by aspen, balsam poplar (*Populus balsamifera*), birch (*Betula papyrifera*), and alder (*Alnus crispa*). Further research will entail developing a spatially explicit model relating the distribution of fire severity with the vegetation production and removal by moose to further understand the utilization of winter forage in post-fire habitat.

103. POLARities Exhibit Artist Presentation

Keren Lowell

The artist will talk about some of the visual sources for her work. She will show images of viral colonies, fungus, cellular structures, chromosomal groups, tissue samples and crowd clusters.

104. Patterns & Trends in Subsistence Salmon Harvests, Norton Sound and Port Clarence, 1994-2003

James Magdanz, Eric Trigg, Austin Ahmasuk, Peter Nanouk, David Koster, Kurt Kamletz

In Alaska there is a large and growing body of time-series subsistence harvest data collected by government agencies, tribes, and Native corporations. Although these data are used extensively in regulatory processes, they rarely have been used to explore ecological, social, or economic changes. This study explored patterns and trends in subsistence salmon harvests in ten communities in the Norton Sound – Port Clarence Area from 1994-2003. The data file included 7,838 individual household harvest records (88.1 percent of the occupied households in the population).

From 1994 to 2003, estimated subsistence salmon harvests declined by 5.8 percent annually. Most of the declines occurred during the first five years (1994-1998), when harvests declined by about 8 percent annually. During the latter years (1999-2003), harvests declined by about 1 percent annually across all communities. While harvests appeared to stabilize in the latter years, it would not be correct to characterize the overall situation as improving, at least through 2003. For half of the study communities, the lowest estimated harvests occurred in 2003.

Despite the declines, stable patterns of household harvests were evident. Through many different levels of abundance, through a decade of varied weather, with harvests ranging from 67,000 to 140,000 salmon, each year about 23 percent (range, 17 to 25 percent) of the households harvested 70 percent of the salmon, by weight. Predictable patterns were apparent in the harvests by the age and gender of household heads. Setting aside teacher households and households that usually did not fish, harvests increased with the age of the household heads, and decreased when household

heads were single, especially single males. Households that consistently harvested salmon also were among the high harvesting households in their communities. Given these predictable overall patterns, it was reasonable to assume that the same households were responsible for a majority of the harvests each year. While some households did contribute consistently to the community harvest, in every community there were many unpredictable households.

105. Dynamic Tradition, Tumultuous Landscape: Inupiaq Responses to Changing Freshwater Regimes on the Seward Peninsula

Elizabeth Marino, Peter Schweitzer, Josh Wisniewski, Jack Omelak

Over the last 30 years, appreciable climate change has been observed in the Arctic and recent studies indicate that this change in climate will significantly affect Arctic hydrological systems. As human life is dependent on water for survival, among other things, changing fresh water regimes in the Arctic alter ways in which communities are able to collect water, travel on the land, participate in subsistence economies, and experience landscape.

This paper has two main goals. First, it will provide an overview of fresh water use in four communities on the Seward Peninsula. Secondly, it will address the question how changes to the freshwater environment are perceived and experienced in different communities and which strategies are employed to respond to them. Our data show significant local differences in the impact of change, the valuation of change, and – accordingly – the ways to cope with them. Generally, it seems that adaptation among Inupiat today involves a creative mix of traditional and modern strategies for living with and within a dynamic environment.

Beyond the documentation of local perceptions and responses, the paper raises general questions about the adaptability of subsistence-based societies to environmental and social changes. Obviously, the Arctic has always been a tumultuous and dynamic environment and Arctic peoples have continuously demonstrated their abilities of adapting to dynamic systems. Today, as climate change and socio-economic change are co-existing phenomena in indigenous Arctic communities, new strategies are becoming necessary. The main interest of the authors is to better understand the intersection of changing environments and changing societies, as perceived through and acted upon dynamic cultural practices.

106. Arctic Listening Post

Jane Marsching

Arctic Listening Post draws upon scientific data to create video, netart, and digital images that examine the Arctic as a place seemingly unattainable and remote and yet upon the health of which the future of this planet is largely dependent. Vaudevillian spectacles, 3D renderings, scientific webcam images, and online conversations create a project about our human relationship to the issues of climate change and the Arctic.

107. Twenty-five Years of North Slope Inupiat Living Conditions

Stephanie Martin

This research combines survey data from the North Slope Borough surveys and the Survey of Living Conditions in the Arctic (SLiCA) to describe how life has changed for North Slope Inupiat over the 25 years from 1978 through 2003. In part, it updates findings from Kruse's 1991 paper, "Alaska Inupiat Subsistence and Wage Employment Patterns, Understanding Individual Choice". This research describes changes in household structure, trends in household income, subsistence participation, food sharing, and how households mix subsistence and employment opportunities. It compares the effects of change on men and women and between Barrow and the villages.

108. Persistent Organic Pollutants Analysis in *Saxidomus giganteus* and *Siliqua patula* in Cook Inlet, Alaska

Holly Martinson, John Kennish

Polychlorinated biphenyls (PCBs) and various pesticides commonly known as persistent organic pollutants (POPs) are known compounds that pose a significant risk to public health and the environment. Concentrations of POPs are being

evaluated in species of bivalves collected from Ninilchik and Sadie Cove beaches located within Cook Inlet, Alaska. The species of interest are *Saxidomus giganteus*, the butter clam, and *Siliqua patula*, the pacific razor clam. The bivalves were harvested four times from May to August and analyzed for contamination using the ASE 200 for extraction and GC-ECD for analysis. By knowing the concentrations of POPs found in the bivalves sampled, Environmental Protection Agency guidelines can be used to determine how many bivalves from the Cook Inlet area can be consumed before causing a health risk. The results from the experiment will be useful for determining POP guidelines and benefit everyone that harvests bivalves in the Cook Inlet area.

109. Quantitative Sampling of Vegetation Recovery on Disturbed Marine Tundra, Amchitka Island, Alaska

Richard Marty, Amy Forman, Tim Echelard, John Jones, Pete Sanders, Pat Matthews

Quantitative surveys of vegetation cover on caps emplaced to contain drilling mud residuals from boreholes emplaced to support weapons testing allow the determination of re-establishment rates for native species on disturbed sites in the marine tundra. The caps cover drilling mud which was contaminated with diesel-range organic compounds during drilling, and the mud was mixed with native soil from an on-site borrow area before the areas were capped. The mixed mud was buried under an additional soil layer and graded to promote surface water runoff before a 30-mil liner was emplaced and buried beneath an upper soil layer. The surface soil was graded and covered with a seed mat with a mix of 40% Boreal Red Fescue (*Festuca rubra* L. var. Boreal) and 60% Norcast Bering Hairgrass (*Deschampsia beringensis* Hultén).

Vegetation on the island is zoned along a moisture gradient from sedentary fen to wind desiccated subshrub-grass stripe communities. Caps were emplaced within the Crowberry meadow vegetation type of Amundsen (1972) [2 of 7 sites]. Caps also were constructed in the wetland tundra community [1 of 7 sites]; in a previously disturbed crowberry meadow community [1 of 7 sites]; in areas transitional from the crowberry meadow to the crowberry stripe community [2 of 7 sites]; and in the crowberry stripe community itself [1 of 7 sites]. Earlier authors predicted slow recovery of the tundra especially in areas scoured by wind.

The summer, 2006 survey of the caps allow recovery rates to be determined in the different communities.

110. Leveraging the 125 Year Legacy of the International Polar Year To Support the Earth and Space Science Education Revolution

Mark McCaffrey, Rhian Salmon, Jean de Pomereu

The first of the "international years", the International Polar Year was the vision of Austrian explorer Karl Weyprecht's who, in the 1870s, foresaw the need for coordinated, intensive international study of the polar regions of the Earth through a full annual cycle. The first International Polar Year (IPY) in 1882-3 focused on studying the basic geography of the polar regions and collecting weather data. The subsequent Second IPY in 1932-33, built on the prior research but expanded exploration into space, examining the ionosphere and behavior of radio waves and auroras. The International Geophysical Year, 1957-8, which was an expanded IPY, further explored polar regions and included the first Earth orbiting satellite, Sputnik. In the U.S., a series of science education films were developed that inspired a generation of young scientists to study the Earth system. Over the past 125 years, society has changed in profound ways, and the upcoming IPY and its long legacy of international collaboration and cooperation in polar science and global linkages offers a timely opportunity to showcase brilliant science and provide a compelling context for how scientists collect evidence of global change.

111. Meeting Remote Educational Challenges in Science

Suzanne McCarthy

Offering Geo-Science education throughout rural Alaska has proven to be a rewarding challenge. Through creative funding and grants, Prince William Sound Community College offers courses in 6 remote sites over a 33,000 mile area including Prince William Sound and the Copper River Basin region. Classroom sites that receive lectures and laboratory exercises are Glennallen, Valdez, Cordova, Chitina, Kenny Lake and Chistochina. Special technological challenges demand creative problem solving. Technology has changed the paths of information exchange; opening

doors for place-bound students with opportunities to receive a college level education. Classes are delivered by real-time interactive video, utilizing accessories such as digital scanning, and ELMO, which can project and magnify a crystal's delicate form.

Education in remote villages throughout Alaska is very problematic. Cost and retention of teachers prohibit continuity and stability of the educational process. Land and resource management in many of these regions can be critical to state and national economies. Geo-Science education, which leads to responsible land and resource decisions, is critical for these isolated populations. Educational opportunities create positive synergy and a thirst for knowledge.

Unwilling traditional instructors feel that the learning experience is deflated without face to face contact. Even more interesting, faculty often resists teaching to remote regions. Reasons for resistance include teaching techniques, fear of technology, technological stability, proctoring of work, and lack of personal contact in lieu of electronic communication. Our students show that quality is not sacrificed. Interestingly, students who have taken our courses are committed, motivated and successful. This may be due to the lack of past educational opportunities.

As technology has developed, access to the world has become immediate. Outsourcing of jobs, businesses operating without physical buildings, residency for employment need not be in the same city, state or country. Educational delivery must also evolve to effectively utilize technology and excel at delivering education using new technology and expanding the classroom.

112. Wild Alaskan Bog Blueberries Contain a Sphingomyelinase-Inhibiting Component That Protects Against Neuroinflammation

Colin McGill, Brian Barth, Sally Brown, Tom Kuhn, Tom Clausen

Wild Alaskan Bog blueberries are well known to Alaskans as a healthy and wholesome fruit. Research has suggested that blueberries, as well as other natural products, contain compounds of considerable therapeutic potential. It has been suggested that components of blueberries may be beneficial for individuals affected by disorders of the central nervous system. One potential molecular target of blueberry components is the pathway linking inflammatory mediators to the onset and progression of neurodegeneration. Sphingomyelinase-mediated generation of the bioactive sphingolipid ceramide is an important step in this neuroinflammatory pathway.

In our study we prepared extracts of wild Alaskan Bog blueberries by lyophilizing and crushing whole berries, followed by freeze-drying, and subsequent extraction without hydrolysis. Blueberry extracts were separated based on solubility then subjected to flash-column chromatographic separation on Sephadex LH-20 and silica gel. HPLC and GC-MS were used to characterize fractions. Fractions were applied to SH-SY5Y human neuroblastoma cells prior to treatment with tumor necrosis factor alpha. Activity was subsequently assayed using an Amplex Red Sphingomyelinase Assay kit (Invitrogen, Carlsbad, CA). Neuroinflammation was further evaluated by monitoring oxidative damage to cellular components.

Taken together, our research identifies for the first time, components from wild Alaskan Bog blueberries as specific sphingomyelinase inhibitors, linking the beneficial effects of blueberries to the reduction of neuroinflammation. Further characterization of these components will allow for the development of better preventative strategies as well as treatments for various neurological disorders.

113. Using Stable Isotope Analysis of Archaeologically Deposited Pacific Cod (*Gadus Macrocephalus*) as a Proxy for Understanding Changes in Ecosystem Productivity

Holly McKinney

The Gulf of Alaska has experienced dynamic variability in ecosystem productivity over the past 1700 years. Changes in sea level, ocean temperature and prey availability have been observed. These productivity changes both affect and are affected by human populations living in coastal regions. By examining the archaeofaunal remains from well-defined radiocarbon-dated stratigraphic levels from the Mink Island site (XMK-030), a link between ecosystem productivity change and human habitation change may be observed. Collagen was extracted from a sample of 28 Pacific cod (*Gadus macrocephalus*) angulars (lower jaw bones) from Mink Island. $\delta^{15}\text{N}$ (‰, AIR) and $\delta^{13}\text{C}$ (‰, VPDB) values were

run using an EA IRMS continuous flow system. Changes in ^{15}N values indicate changes in the trophic level in which the Pacific cod were feeding. Changes in ^{13}C values indicate changes in primary productivity of the marine ecosystem. If primary production increases, ^{13}C values will increase, causing changes in dietary breadth, indicated by decreasing ^{15}N values. Inversely, if the ^{13}C values decrease, the ^{15}N values will increase. This current data indicates that there is a cyclical fluctuation in primary productivity in the Gulf of Alaska, with ^{13}C values increasing and decreasing over the past 1700 years. The trophic level in which the Pacific cod ate at (^{15}N) is expected to fluctuate over time in the same manner as the ^{13}C values. This is not the case, in spite of higher productivity; the Pacific cod at Mink Island ate at higher trophic levels at all time periods except for an abrupt lowering between 1000 BP and 1300 BP. There is a change in cultural adaptation at around 1300 BP to 1000 BP that correlates with the lowering in trophic level feeding of Pacific cod. This cultural adaptation is called the Kukak Beach Phase that is characterized by the presence of large villages, shell middens, expanded population densities, increased sedentism, and a possible shift in subsistence strategies; focusing more on fish resources. This increase in procurement intensity by the humans at Mink Island may have affected the feeding habits of Pacific cod.

114. Climate Change and Variability in Interior Alaska: An Interdisciplinary Approach to Data Integration and Synthesis for Understanding Regional Patterns Relevant to Stakeholders

Shannon McNeeley, Martha Shulski, Karin Lemkuhl, John Walsh

EPSCoR Poster

115. POLARities Exhibit Artist Presentation

Da-ka-xeen Mehner

The artist talks about Native American art in relation to Federal Government's Blood Quantum registration: "When Science Defines Culture: Federal Blood Quantum Registration and Native American Identity."

Since 1886 with the Congressional General Allotment Act, the U.S. Government established its social responsibility towards Native American peoples based on blood quantum, and simultaneously began to define and deny heritage based on this standard. As historian Patricia Nelson Limerick summarized in *The Legacy of Conquest: The Unbroken Past of the American West*, "Set the blood quantum at one-quarter, hold to it as a rigid definition of Indians, let intermarriage proceed as it had for centuries, and eventually Indians will be defined out of existence. When that happens, the federal government will be freed of its persistent 'Indian problem.'"

My artwork attempts to describe the experience of a Native American man, from the point of view of this definition. This experience of being only 9/16 of a person and 7/16 of an Indian as defined by science, society, and law has provoked this body of work, and the work of many other Native American artists. This presentation will include an overview of my work in relation to this issue, as well as the work of other artists who struggle to define themselves outside of the blood quantum system.

116. Oil & Gas Development in the Arctic Ring of Life: Mapping the Risks

Pamela Miller

The area known as the "Arctic Ring of Life," named by a Russian polar bear biologist for the bountiful zone where sea ice meets the northern edge of continents and animals concentrate in great numbers is rapidly changing from global warming and industrial activities. In Alaska's arctic, oil and gas leasing has expanded at a dramatic pace on land and in the ocean since 1999, greatly increasing the risks from exploration and development to coastal wetlands and wildlife, indigenous cultures, shorelines, and marine ecosystems. I present case studies of North Slope oil and gas exploration and development projects including expansion of the Alpine field, Teshekpuk Lake protection, and the misleading "2,000-acre footprint" of oil development for the Arctic National Wildlife Refuge.

In the National Petroleum Reserve – Alaska, the Bureau of Land Management (BLM) has offered over 12 million acres of land in oil and gas lease sales and the agency plans a September auction in internationally significant goose molting and caribou calving areas of Teshekpuk Lake Special Area. Instead of removing critical areas from leasing plans as

past Interior Secretaries have done, BLM proposes land use stipulations insufficient to protect critical habitat areas according to scientists and indigenous communities. While the agency presents complex maps implying protection, conservationists used GIS mapping to show sprawling infrastructure and disruptive activities that could be allowed in the Teshekpuk Lake habitats. For the first oil development project in the National Petroleum Reserve-Alaska, BLM has completed its environmental impact analysis and approved permanent roads and facilities within “no surface occupancy” buffer zones and other waivers of environmental stipulations.

In the Beaufort and Chukchi Seas there is a massive increase in offshore leasing plans, seismic exploration, and development planning now underway despite high cultural and environmental costs. Conservationists used GIS maps as one tool for explaining the cumulative scope of the new plans, compiling information that federal agencies reviewed on individual maps.

The Arctic National Wildlife Refuge is the only area of Alaska’s arctic coastal plain and foothills that remains protected from oil and gas exploration and development by law. GIS mapping is one tool to show how oil development proponents inaccurately characterize the magnitude of proposed leasing and industrialization as a compact “2,000-acre” footprint during the national controversy over oil drilling and development for the 1.5 million-acre coastal plain area scientists call the biological heart of the refuge.

117. The Greening of the Upper Kuparuk River Region

Corinne Munger, Donald Walker

We examined a 15-year history (1985-1999) of vegetation greenness in the Toolik Lake area using Landsat TM data. Other investigators have detected a recent trend of increased greenness in Northern Alaska using global 1-km normalized difference vegetation index (NDVI) data derived from the Advanced Very-High Resolution Radiometer (AVHRR). Our analysis with finer-resolution (30-m) data permitted an independent analysis of the long-term trend and allowed us to examine the heterogeneity of greening across the landscape. We analyzed the temporal and spatial trends in the NDVI calculated from three Landsat satellite images for the Upper Kuparuk River area in northern Alaska taken during phenologically similar times of maximum aboveground productivity of vascular plants. To determine if greening was landscape-wide or concentrated in certain vegetation or landscape units, the NDVI values for these three images were analyzed in relationship to mapped plant communities, glacial geology, surficial geomorphology, slope, aspect, and proximity to water tracks. The overall increase in NDVI in the Toolik Lake region between 1985 and 1999 was 13.8%, which is slightly less than the 16.9% increase that was detected across the entire Alaskan arctic during the longer period of 1981-2001 using AVHRR data. There were generally only small differences in the degree of greening that occurred in different vegetation types. The largest change in NDVI occurred in rich fens (17.7%), moist acidic tundra (16.8%), dry acidic tundra (16.6%), and moist nonacidic tundra (16.3%). Barren areas had the smallest increase in NDVI (12.1%). Younger glacial surfaces showed a greater change in NDVI than older surfaces (Itkillik II 17.3 %, Itkillik I 16.6%, and Sagavanirktok 13.5%). NDVI on disturbed surfaces (revegetated roads and gravel pads) showed the largest change (22.9%), followed by nonsorted circles (18.9%), upland turf hummocks (18.6%), and areas of wetland microrelief (17.2%). This independent analysis confirms a remarkable overall greening for the region that was first detected using AVHRR data and is supported by ground-level observations of increased shrub cover in the region. The meaning of these observations with respect to biomass and species level change now needs to be examined with long-term repeated ground-level measurements of biomass, vegetation structure, species cover, and NDVI.

118. Impact of Wildfire Induced Land-Cover Changes on Clouds and Precipitation in Interior Alaska

Nicole Mölders, Gerhard Kramm

As especially observed during the 2004 Alaska fire season, huge wildfires drastically alter land cover leading to a change in the dynamic (roughness length), radiative (albedo, emissivity), vegetative (vegetation type and fraction, stomatal resistance), thermal (soil heating, thawing of permafrost), and hydrological (water loss due to the fire) surface characteristics. A case study was performed with the Mesoscale Model generation 5 (MM5) assuming the landscape prior to and after the 2004 wildfires in Interior Alaska to quantitatively examine the impact of fire-caused land-cover changes on summer cloud and precipitation formation. The results of our model study show that sensible heat fluxes

into the atmosphere and air temperatures increase by up to 225 Wm⁻² and 3 K over burnt areas. Burnt areas > 600 km² and > 800 km² significantly (at the 90% or higher confidence level according to statistical tests) affect sensible and latent heat fluxes, respectively. While burnt areas must exceed 1,600 km² for the increased buoyancy to significantly increase the upward transport of air, burnt areas > 600 km² already experience enough enhanced lifting to produce areas of increased cloud-water, rainwater, and graupel mixing ratios followed by an area of decreased mixing ratios downwind of them. The spatial and temporal distribution of precipitation changes appreciably and resulted in significant increases of 84h-accumulated precipitation (by up to 15.1 mm) in the lee of burnt areas > 600 km², but a decrease by 0.1 mm on the domain average.

119. Seasonal Changes in the Reproductive Organs and Body Condition of Northern Redbacked Voles (*Clethrionomys rutilus*)

Lorena Nay, Kalb Stevenson, Ian Van Tets

Arvicoline rodents (voles and lemmings) are small, non-hibernating mammals that inhabit northern temperate, sub-arctic, and arctic environments. They are a major food source for predatory birds and mammals and are important for plant distribution. Vole reproduction generally peaks in summer, and although reproductive traits are species specific, almost all arvicolines have been known to breed throughout the year, even in winter. Our aim was to identify the seasonal range in which reproduction occurs for this species, to determine how reproductive organs are affected by season, and to determine whether relationships exist between body condition and reproductive condition. To achieve our aim, we measured seasonal changes in three male organ masses (seminal vesicle, testis, and epididymis) and two female organ masses (ovary and uterus), used histological methods to define male reproductive state, and measured body condition using dual-energy X-ray absorptiometry (DXA). We predict that the relative organ masses vary seasonally, but do not change at uniform rates. It is likely that there will be strong correlations between the organ masses and some body condition parameters predicted by DXA. Our results will allow us to identify the months and seasons in which *C. rutilus*, an important prey species in coastal southcentral Alaska, is most likely to reproduce, and what portion of the population is reproductive in each season. We will also determine the effect of season on the rate of change of each organ mass, and how body condition adjusts to facilitate voles' specific reproductive and energetic requirements.

120. Reduction of Pollution and Energy Saving in Ships in the Arctic Region Using Nanofluids

Praveen Namburu, Devdatta Kulkarni, Debendra Das

Nanofluids are a new generation of engineered fluids with suspension of nanometer size metallic particles of high thermal conductivity that are showing the promise of enhancing heat transfer coefficient remarkably in comparison to the existing heat transfer fluids. Many ships operate in the arctic regions for transportation of goods, tourism and also for national defense. By heating the hull of a ship, the viscosity of water in the boundary layer is reduced, which causes a reduction in the skin friction on the hull. Thus the drag can be reduced and the ship propulsive power requirement will decrease. The waste heat from jacket water and exhaust gases of engines of the ship can be recovered by nanofluids to heat the hull. The Alaska Marine Highway System operates several ships and there are many barges and boats operating in Alaskan rivers and coastal waters. They will all benefit from this drag reduction, which will result in less fuel consumption. Due to its higher thermal efficiency, use of nanofluids promises energy conservation and reduction in the discharge of pollutants to the environment. This will be a great benefit from the viewpoint of global warming that is more pronounced in the arctic regions. We have considered an Alaska Marine Highway ship and have calculated the drag reduction. The calculations reveal that a propulsion power saving of about 105 kW can be realized for a ship by heating the hull to 80°C when the ship is cruising at a speed of 20 Knots. For a ship cruising at 70 % of the time, this translates to an energy saving of 640 MWh. This results in fuel saving and corresponds to reduction of release of CO₂, CO and NO_x to the environment. In this poster we will present a schematic diagram of the ship hull heating system with nanofluids coils and the applicable equations to calculate the power saving.

121. Modeling Reaction of Non-Sorted Circles to Changes in Climate, in the Active Layer Depth and in Vegetation Cover

Dmitri Nicolsky, Vladimir Romanovsky, Donald Walker

We examine sensitivity of a general model of the frost boil dynamics with respect to changes in thermal, rheological and hydraulic properties of the ground material and boundary conditions. We apply the model to non-sorted circles along

the low Arctic Climate gradient and investigate the seasonal dynamics of them. This investigation allows evaluation/determination of physical mechanisms and driving forces that play the most decisive role in creating the differential frost heave in the non-sorted circles. Using this model we explore interactions between vegetation cover and thermo-mechanical processes. As the conclusion, we investigate the reaction of the non-sorted circles at several sites along the Dalton highway in the Arctic tundra in Alaska to changes in climate, in the active layer depth and in vegetation cover.

122. Modeling Permafrost Dynamics by CLM3

Dmitri Nicolsky, Vladimir Alexeev, Vladimir Romanovsky

The Community Land Model (CLM) is the land component of the Community Climate System Model. The CLM is commonly used to simulate dynamics of biogeophysical processes in the ground. In this project, we evaluate performance of the CLM3 in its offline mode to simulate freezing/thawing cycles, depth of the active layer and long-term permafrost evolution. We carry out a systematic sensitivity analysis of the CLM3 with respect to a configuration of soil layers in order to model the temperature dynamics within certain uncertainties. Moreover, we show an importance of incorporating the organically enriched mineral layer in CLM3 to model long-term permafrost evolution accurately. Finally, we discuss inclusion the unfrozen liquid water content in CLM3 and a modification of its numerical scheme to compute soil temperature dynamics more accurately.

123. McCall Glacier and IPY's Glaciodyn Project

Matt Nolan

Glaciodyn was approved by the IPY's Joint Committee as the lead project for research on arctic glaciers during the IPY. Glaciodyn seeks to understand the dynamic responses of arctic glaciers to changes in mass balance and global warming, using common methodologies at over 20 glaciers to develop robust models that will improve predictions of glacier contributions to sea level rise in the future. Glaciodyn emerged from IASC's Working group on Arctic Glaciers, at which 17 member countries have met annually for more than a decade. The project received international endorsement as it addressed nearly all of the goals of IPY, including understanding the current state of the environment, change in the polar regions, and polar-global linkages and tele-connections.

McCall Glacier is the premier US arctic glacier research site, with a research history dating back to the IGY 1957-58, and is the primary US arctic glacier within the Glaciodyn program. Repeated measurements of surface mass balance and volume change over the past 50 years have shown that this glacier, like most in the north-east Brooks Range, has been losing mass at an increasing rate. Local records and global reanalysis data have shown that air temperatures have been increasing, with the biggest increase occurring in the mid-1970s and a more gradual increase since then. Our observations have shown that surface melt on time-scales of hours to decades has an influence ice velocities, making this an interesting glacier at which to study glacier/climate interactions that will have a valuable contribution to Glaciodyn.

In this presentation I will give an overview of the Glaciodyn and McCall Glacier projects, and how their science and outreach are being coordinated for IPY.

124. State of the Arctic Report

James Overland, Jackie Richter-Menge, A. Proshutinsky, Vladimir Romanovsky

The recently published State of the Arctic Report provides an update to some of the physical data records discussed in the Arctic Climate Impact Assessment (ACIA). The Report represents the work of 26 international scientists who developed a consensus on information content and reliability. Many of the trends documented in the ACIA are continuing, but some are not. Taken collectively, the observations presented in this Report indicate that during 2000-2005 the Arctic system shows signs of continued warming. However, there are indications that certain elements may be returning to climatological norms. Of particular note:

- Atmospheric climate patterns are shifting. The late winter/spring pattern for 2000-2005 had new hot spots in NE Canada and the East Siberian Sea relative to 1980-1999.

- Ocean salinity and temperature profiles at the North Pole and in the Beaufort Sea, which changed abruptly in the 1990s, show that conditions since 2000 have relaxed toward the pre-1990 climatology, although the period 2001-2004 has seen an increase in northward ocean heat transport through Bering Strait.
- Sea ice extent in September 2005 was the summer minimum observed during the satellite era beginning in 1979.
- Permafrost temperatures continue to increase. Unlike the permafrost temperatures, data on changes in the near surface active layer thickness are less conclusive.
- There is increasing interest in the stability of the Greenland ice sheet.
- Globally, 2005 was the warmest year in the instrumental record (beginning in 1880) with the Arctic providing a large contribution toward this increase.

125. Evaluation of Climate and Soil Conditions Simulated by the Community Climate System Model Version 3.0 (CCSM3.0) for Russia

Debasish PaiMazumder, Nicole Mölders

Accurate prediction of soil temperatures, freezing and thawing of the active layer depth is important for ecosystem, biogeochemical process and high latitude hydrology studies. The soil temperature at different depths simulated by Community Climate System Model Version 3.0 (CCSM) is evaluated over Russia for three climate episodes (1951-1980, 1961-1990, and 1971-2000) by means of observations provided by the National Snow Ice Data Centre (NSIDC). The CCSM well captures the annual phase of the soil temperature cycle, but not the amplitude. It predicts slightly too high (low) soil temperature in winter (summer). Root mean square error (RMSE), on average, are less than 4 K. The predictions of near-surface temperatures well agree with those from the European Centre for Medium-Range Weather Forecasts reanalysis (ERA-40) data. Thus, the simulated atmospheric temperature forcing is not the cause of the discrepancy in soil temperature prediction. Evaluation of precipitation predicted by the CCSM by means of the observations obtained from Global Precipitation Climatology Centre suggests that an inaccurate prediction of the precipitation may be the reason of the underestimation of soil temperature in summer. Evaluation of simulated snow depth by means of observations indicates that overestimation of snow depth may contribute to the overestimation of soil temperature in winter. The lower boundary conditions of the model also have great impact on the overall performance of the model. An accurate prediction of the soil temperature requires an accurate lower boundary condition and stability between the precision and the computational time of the model. Future investigations will focus on the sensitivity study of the soil type alone with its effect on inaccurate predictions of the soil temperature and an evaluation of the soil moisture.

126. Over-Winter Movements of Arctic Foxes (*Alopex lagopus*) on Alaska's North Slope using Satellite Telemetry

Nate Pamperin, Erich Follmann

Using satellite telemetry, we investigated movements, especially winter movements, of arctic foxes (*Alopex lagopus*) collared in a developed area (Prudhoe Bay Oil Field) and an undeveloped area (National Petroleum Reserve-Alaska). The main focus of the study was to determine whether foxes in a developed area remain there through winter due to the availability of anthropogenic foods that are unavailable in an undeveloped area where foxes are expected to roam more widely in search of food. A total of 37 foxes were collared from 2004-2005; 17 from NPR-A and 20 from Prudhoe Bay. Movements of animals from Prudhoe Bay were restricted to the oilfield, while movements of greater than 150km from capture site were common for most animals collared in NPR-A, with some animals traveling in excess of 800km. We also documented the use of sea ice by three foxes collared in NPR-A, but did not see similar use of sea ice by foxes from Prudhoe Bay.

127. Arctic Human Health Initiative

Alan Parkinson, Pamela Orr, Neil Murphy

The Arctic Human Health Initiative (AHHI) is an Arctic Council IPY coordinating project that aims to increase the visibility and awareness of health concerns of Arctic peoples, to foster human health research, and promote health protection strategies that will improve the health and well-being of all Arctic Residents. The AHHI core project will seek to advance the joint circumpolar human health research agendas of the Arctic Council (AC; www.arcticcouncil.org),

an eight nation intergovernmental forum for sustainable development and environmental protection, and the working groups of the International Union for Circumpolar Health (IUCH). Current AC human health activities include monitoring the human health impact of anthropogenic pollutants, climate variability, infectious diseases, and the expansion and assessment of tele-health innovations in Arctic regions. The IUCH (www.iuch.org) promotes international cooperation, research, scientific information exchange and education in the areas of Arctic Health Policy, Birth Defects & Genetics, Cancer, Diet & Heart, Environmental Health & Subsistence Food Security, Family Health, Fetal Alcohol Syndrome, Health Surveys, HIV/AIDS, STDs, Indigenous Peoples Health, Infectious Diseases, Injury Prevention, Occupational Safety & Health, Population-Based Planning, Tobacco & Health, and Women's Health.

A key element of the AHHI will be the development of new, and expansion of existing human health surveillance, monitoring and research networks. Research activities will focus on the human health impact of: Regional and inter-continently transported anthropogenic pollution in Arctic regions; Oil, gas and other sustainable development activities; Contaminants and zoonotic infectious diseases on the traditional food supply; Climate variability on human health and traditional food supply; Infectious diseases including tuberculosis, HIV/AIDS, hepatitis, vaccine preventable diseases, emerging infectious diseases such as SARS; The effects of the changing Arctic environment on the evolution, ecology, and emergence of zoonotic disease, particularly avian influenza; Chronic diseases such as cancer, cardiovascular diseases, obesity and diabetes; Behavioural health issues, such as suicide, interpersonal violence and substance abuse, and unintentional injuries.

A goal of the AHHI is the development of sustainable partnerships between communities and researcher through the establishment of community-based monitoring and research activities that will result in translation of research findings into health policy and implementation of community/public health interventions.

128. Implications of Fluid Dynamics inside Arctic Sea Ice Sheets on Thermohaline Circulation and Biological Activity

Chris Petrich, Pat Langhorne, Hajo Eicken

Arctic sea ice is a dynamic environment that interacts with both ocean and atmosphere. During the growth season, sea ice rejects over two thirds of the salt contained in seawater into the underlying ocean. The rejected brine contributes to the global distribution of water masses, the ventilation of the oceans and the transport of natural and anthropogenic substances from surface to depth. The liquid brine entrapped in the sea ice creates a transient environment of pockets and pathways. As temperatures decrease, the brine salinity increases to several times the salinity of the open ocean. A cold-adapted biological community develops in the sea ice matrix, with most of the algal biomass residing in the lowermost layers of the ice cover. For these bottom communities, replenishment of nutrients, as constrained by ice permeability and ad-/convective transport, is crucial in determining total biomass build-up over the course of the ice growth season. During summer melt, when the pore space in sea ice widens and meltwater percolates through the ice column, the boundary conditions for biological production in sea ice change drastically and biota are released into the water underneath. The flora and fauna that thrives in and under the sea ice cover is an important component of the Arctic food web that ultimately impacts fish and marine mammals.

This modeling study investigates how transport processes inside sea ice sheets influence the production of saltwater and freshwater fluxes and may impact the seasonal evolution of the sea ice habitat. We demonstrate here how fluid dynamics simulations describe the natural redistribution of brine within an ice sheet and the salt flux into the ocean during the ice growth phase. The two-dimensional Navier--Stokes Equations are solved numerically to simulate fluid transport in the coupled sea ice--ocean system. Oceanic heat flux is found to influence the vertical salinity profile, and a parameterization of sea ice salinity is suggested that accounts for this. One future goal of this work is to examine possible changes in ice-associated biomass driven by the replacement of multiyear ice (with lower ice--ocean salt fluxes and substantially lower biomass than first-year ice) with first-year ice in the Arctic Ocean. To describe the evolution of the sea ice habitat in spring and summer, we will extend the fluid dynamics model to include the absorption of solar radiation and the formation of melt ponds.

129. The Controlling Factor in Soil Formation in Arctic Tundra

Chien-Lu Ping, John Kimble, Gary Michaelson, Yuri Shur, Donald Walker

Jenny's state factors of soil formation include parent material, climate, organisms topography, and time. These factors

apply well to soils of the temperate regions and seasonal frozen ground but in the arctic regions, the presence of permafrost strongly affect the roles of these factors in soil formation. Parent materials in the Arctic varied widely from residual, colluvial, glacial, alluvial, marine, and eolian deposits. The nature of these deposits controls soil physical and chemical properties. Due to the low rate of weathering in the arctic region, the primary minerals in the parent materials are least altered. The climate of the arctic region is characterized by cold ambient temperatures, short growing seasons, and the presence of permafrost. A unique characteristic of arctic soils is that they contain large amounts of water in the form of ice. The dynamic nature of ice formation accompanied by frost heaving and thermal contraction of frozen soils, and melting of ice with settlement of thawing soils drive cryoturbation, resulting in cryogenic structures at the pedon level and the formation of patterned ground at the landscape level. The climate factor in the Arctic limit biomass production, organic matter decomposition, and other biogeochemical processes in the soil. The presence of permafrost serves as a barrier to root and water penetration. Frost heave causes cryoturbated soil and redistribution of soil organic carbon and other nutrients. In dry coarse textured soils, such as on sand dunes and well drained ridgetops the permafrost contains insufficient ice to cause cryoturbation. In finer-grained soils and on lower slope positions, permafrost causes a perched water table with saturated reducing conditions above the permafrost. Organisms contribute to the accumulation of organic matter due to the cold, wet thus reducing conditions. Vegetation and the surface organic horizons play a critical role in modifying the frost boil process because of their insulation effects. Another unique characteristics of arctic soil is that elements are reduced in the frozen state such as in the permafrost layer. Topography redistribute solar energy and moisture thus affects vegetation community in arctic tundra. Topography controls hydrology that regulates saturation and reducing conditions which in turn affect the rate of organic matter decomposition/accumulation. In Arctic Alaska time left little mark on soil formation due to gelifluction and cryoturbation. The uniqueness of soil formation in the Arctic is cryogenesis caused by ice formation in the profile and by the underlying permafrost. and related biogeochemical processes at subzero temperatures.

130. GoNorth! - Motivating Students LIVE from the Arctic

Mille Porsild, Aaron Doering, Paul Pregont

GoNorth! is a free adventure learning program for the K-12 classroom developed at the University of Minnesota. Circumnavigating the Arctic in five annual Arctic dogsled expeditions (2006 – 2010) GoNorth! motivates student learning while bridging Arctic communities, scientific field research and K-12 classrooms throughout the world.

The online education program is anchored in inquiry-based natural and social science curricula for the K-12 classrooms. GoNorth! provides participating classrooms with a free 300+ page curriculum and activity guide - a different set for each trek reflecting the Arctic locale, its associated culture and a driving environmental question. Activities on the trail are synched real-time to the curriculum. Each spring, during the 14-16 week LIVE event, learners enter the online classroom for powerful collaborative opportunities, field-updates and research findings. While collaborating with students and teachers live in the Online Classroom, the expedition team of educators, scientist and explorers document environmental field realities relevant to understanding patterns of climate change. Field research includes collection of traditional ecological knowledge (TEK) and hydro-meteorological data with the Office of Polar Programs at National Science Foundation and National Aeronautics and Space Administration. This scientific research in turn coincides with the weekly curricula modules, as each module focuses on the traditional knowledge of the location as well as the associated western science. The adventure learning curricula fueled by scientific field research provides a rare opportunity for scientific comparison and cultural appreciation building opportunity for the learner to formulate decisions about environmental stewardship. Furthermore, students and teachers gain in-depth knowledge of each remote region along with their own communities as their experiences parallel those of the team on the trail. The result is a community of learners on the Internet gaining knowledge from the expedition, subject matter experts, their local community exploration, and from each other.

This past Spring the first annual program took place in Alaska. Across the Yukon Flats, over the Brooks Mountain range and out onto the Arctic Ocean through the Arctic National Wildlife Refuge, GoNorth! was joined by thousands of classrooms in every state and around the world. Engulfed in the adventure, students investigated "oil exploration and sustainable development" while experiencing the Arctic, and learning from the Gwich'in and Inupiat Eskimo peoples in the communities throughout the journey.

131. Observations of Whistler and Z-Mode Echoes on the IMAGE Satellite in the Polar Region

Radha Proddaturi, Amani Reddy, Vikas Sonwalkar

EPSCoR Poster

132. “Climate Change” in Global Perspectives: The Kenyan Experience

Marie Rarieya

This paper analyses climate change challenges in Kenya, their implications for development, and directs attention to major initiatives being undertaken at national and regional levels. First, it examines the present day vulnerability to extreme climate events. Second, it examines the impact of climate variability and change in Kenya. Finally, it describes national and regional initiatives involving Greater Horn of African countries' response to the challenges of climate change. The paper concludes with some suggestions for actions that can be undertaken to mitigate the socio-economic impacts of climate change.

Kenya is a critical site for consideration of climate changes issues for a number of reasons. While climate changes are felt globally, their impacts are disproportionately distributed, especially in Sub-Saharan Africa, where the world's poor remain most susceptible to the potential damages inherent in a changing climate. Sub-Saharan Africa is one of the world's most ecologically vulnerable to effects of climate change. At the same time, these countries are least equipped to adapt to the effects of climate change. Extreme events such as drought and floods are becoming more frequent and more severe. Floods lead to loss of life and property, displacement of people and animals, environmental degradation, destruction of infrastructure, adverse effect on the economy, among many other socio-economic problems. Drought on the other hand has harsh negative impacts on tourism, livestock, agriculture, and human livelihoods. In Kenya, when rains fail, which happens frequently, the people, especially in the Northeastern and Coastal region are reduced to near destitution and become dependent on food relief. This paper draws on ten months of fieldwork undertaken in Nairobi and Western Kenya 2005-06 involving ethnographic interviews with experts, local community and policy makers.

133. Satellite Land Surface Temperatures and Tundra Vegetation

Martha Reynolds, Donald Walker

Mapping and understanding where different types of tundra vegetation grow is especially important at a time when arctic climate is changing. Vegetation patterns have been shown to correspond well with north-south summer temperature gradients that are summarized using bioclimate zones. Here we compare AVHRR satellite-derived land-surface temperatures with bioclimate zones as mapped for the Circumpolar Arctic Vegetation Map. Satellite temperatures are used to calculate summer warmth index (sum of monthly means warmer than 0 °C). Means of the temperatures for bioclimate zones from the two sources match well, and the overall spatial distribution is comparable. The satellite data is at a finer scale than the CAVM mapping and can be used to improve the level of detail of the zone map. Areas of discrepancies between the two may be due to one of three causes: errors in the CAVM bioclimate zone mapping, errors in the satellite temperature data, and recent changes in climate to which the vegetation has not yet adapted. Alaska is used as an example to examine the causes of discrepancies in different areas.

134. A Dissolved Oxygen Model to Help Manage Water Use in Arctic Lakes

Daniel Reichardt, Daniel White, Elizabeth Binning, Michael Lilly, Molly Chambers

Dissolved oxygen (DO) in arctic lakes is a key factor for winter survival of fish. Management of water use from lakes indirectly attempts to manage DO through volume limitations of water used on an annual basis, or during seasonal periods. The relationship between water volume, DO budgets, and extraction of water through pumping has historically not been well understood or taken into account for managing water-extraction volumes and timing of extraction. DO budget modeling tools can be used to help predict the amount of DO available at end of winter. Factors such as bathymetry, DO consumption, and timing of recharge should be taken into account in using a DO management model for regulating lake water use. The model being presented has been developed to describe DO concentrations as they are affected by bacterial respiration, and freezing exclusion. Further development will include metals reduction and removal of water during periods of ice cover. The model was developed with data taken from 2 natural arctic thaw-lakes and 2 flooded gravel mine-site locations on the North Slope of Alaska.

135. Prevalence of Trypanosoma Species in Alaska

Sarah Reiling, Amanda Read, George Happ

Representatives of the genus *Trypanosoma* are distributed worldwide and can be found in all classes of vertebrates including most mammals and birds. Once infected, the parasite stays present in the blood stream throughout the life of the host and can be transmitted to other individuals via blood-sucking arthropods. The incidence of infection depends not only on the host susceptibility to the parasite, but also on the vector presence and distinct host specificity of the *Trypanosoma* species. Rate of infection of songbirds and raptors is approximately <1-7% however in Alaska this is increased to 39% for passerines, this is probably due to high vector presence. *T. avium* was the most prevalent of all parasites. No vector investigations were performed and the mosquito species that are known to transmit the parasites to birds on the European continent do not occur in Alaska. Waterfowl are not as susceptible to *Trypanosoma avium* as other bird species and it has been demonstrated that experimental infections are unsuccessful.

Due to the high prevalence of *T. avium* in other bird species we first investigated the prevalence of *Trypanosoma* spp. in waterfowl and shorebirds to determine if these bird groups are more susceptible to the parasite due to high vector presence in Alaska.

Second, we examined blood-sucking insects for the presence of trypanosomes using PCR with general trypanosome primers. Data obtained from these molecular surveys allowed us to demonstrate a seasonal increase in trypanosome positive mosquitoes. Using DNA sequencing we were able to carry out a detailed examination of the variety of different *Trypanosoma* species carried by the vectors.

136. Seasonal Study of Sea-Ice Exopolymeric Substances on the Mackenzie Shelf: Implications for the Transport of Sea-Ice Bacteria and Algae

Andrea Riedel, Christine Michel, Michel Gosselin

Bottom sea ice, from under high and low snow cover, and surface water samples were collected in Franklin Bay (Mackenzie shelf) on 21 occasions between 24 February and 20 June 2004 and analyzed for exopolymeric substances (EPS), particulate organic carbon (POC) and chlorophyll *a* (chl *a*). Concentrations of EPS were measured using Alcian blue staining of melted ice samples. Chl *a* and bacterial sinking velocities were also assessed with settling columns, to determine the potential role of EPS in the transport of sea-ice biomass. EPS concentrations in the bottom ice were consistently low in March (avg. 185 µg xeq. l⁻¹), after which they increased to maximum values of 4930 and 10500 µg xeq. l⁻¹ under high and low snow cover, respectively. EPS concentrations in the surface water were consistently two orders of magnitude lower than in the sea ice. Sea-ice EPS concentrations were significantly correlated with sea-ice chl *a* biomass ($r^2 = 0.70$, $p < 0.01$). Sea-ice algae were primarily responsible for EPS production within the sea ice, whereas bacteria produced insignificant amounts of sea-ice EPS. EPS-carbon contributed, on average, 23% of POC concentrations within the sea ice, with maximum values reaching 72% during the melt period. Median chl *a* sinking velocities were 0.11 and 0.44 m d⁻¹ under high and low snow cover, respectively. Our results show that EPS had little effect on chl *a* sinking velocities. However, bacterial sinking velocities did appear to be influenced by diatom associated and free EPS within the sea ice. Diatom-associated EPS, could facilitate the attachment of bacteria to algae thereby increasing bacterial sinking velocities, whereas the sinking velocities of bacteria associated with positively buoyant, free EPS, could be reduced. EPS contributed significantly to the sea-ice carbon pool and influenced the sedimentation of sea-ice biomass, which emphasizes the important role of EPS in carbon cycling on Arctic shelves.

137. Sharing Perspectives about Climate, Sea Ice, and Subsistence Walrus Hunting

Martin Robards

We present early data from a project that is integrating perspectives on the recent changes (1952 to the present) in sea ice, weather, and climate in the Bering and Chukchi Seas with reported hunting success, observations, and experiences of subsistence walrus hunters in several Native communities in Alaska and Chukotka, Russia. Our goal is to assess how recent shifts in sea ice since the late 1990s have impacted villager's ability to hunt walrus safely and successfully. Ongoing climate change in the Arctic has resulted in a steady recession of sea ice in the Bering and Chukchi Seas, more open water, earlier break-up, and in later arrival of the fall pack ice. Walrus are an ice-associated marine mammal and their distribution will change in concert with the shifts in sea ice extent, its features, and annual

cycle. Accordingly, subsistence hunters in the northern Bering Sea-Chukchi Sea region have reported that the changes in sea ice (including shore-fast ice) and weather patterns are already altering their ability to hunt walrus; they have voiced concerns about the future implications to their economy, life-style, and cultural traditions. By integrating local and broad scale perspectives on sea ice and walrus hunting we hope to find linkages between locally relevant conditions and broader scale scientific research that can be useful and meaningful to hunters, as well as insightful for researchers interested in the cross scale ecosystem dynamics of the Bering and Chukchi Sea ecosystems.

138. Identification of Brucella Species in Alaskan Mammals

Ariel Robinson, Amanda Read, George Happ

Brucellosis is caused by gram-negative bacteria of the genus *Brucella*. Human infection is characterized by fever, night sweats, fatigue, anorexia, weight loss, headache and arthralgia. In mammals, brucellosis affects the sexual organs, causes abortion, infertility, metritis, orchitis and epididymitis. Previous serological surveys demonstrate prior exposure to *Brucella* species in selected Alaskan wildlife (caribou, wolves and bears). Further studies determined that moose from Northern Alaska had been exposed to *B. suis*, a known pathogen of caribou from arctic Alaska.

This research aims to identify and differentiate *Brucella* species infecting Alaskan wildlife (including ungulates, bears, wolves and polar bear), and to test serologically positive marine mammals for current infection. DNA sequencing and a *Brucella* specific PCR using a genus-specific primer pair developed from the 16S rRNA sequence of *B. abortus* are used to establish and differentiate *Brucella* species. The project will identify species of *Brucella* in Alaskan mammals, and will contribute to an understanding of the risk of spread to humans in Alaska.

139. Experimental increases in Snow Depth Alter Feedback and Surface Processes in the High Arctic

Matthew Rogers, Jeffrey Welker, Seth Arens, Birgit Hagedorn, Ronald Sletten

Winter conditions are changing across the Arctic, including increases in snow across portions of Greenland while the margins of the Greenland Ice Sheet are thinning. These changes, and the consequences of these altered surface dynamics on High Arctic terrestrial ecosystems and their potential feedbacks are however unclear. Increases in snow may result in warmer soils in winter, greater rates of winter C losses, increases in winter N mineralization, shorter growing seasons and reduced net C gain in summer due to either reduced gross photosynthesis or increases in ecosystem respiration. In this study, we have constructed replicated snow fences in a polar semi-desert (prostrate dwarf shrub) in NW Greenland to address these questions: a) how do increases in snow depth alter the surface and subsurface physical and chemical processes of these ecosystems?, and b) to what extent do increases in snow depth alter net CO₂ exchange, gross ecosystem photosynthesis and ecosystem respiration? We have found that in winter, deep snow results in warmer soil temperatures, but in summer areas with deep snow in the previous winter have colder soils temperatures, especially early in the summer but by later summer soil temperatures are the same, irregardless of winter snow depth. Deeper snow results in higher soil water contents in early summer but by mid-July soil water contents are the same, irregardless of previous winter snow conditions. Net ecosystem CO₂ exchange rates are consistently negative (C source to the atmosphere) in June irregardless of previous winter snow depth but mid and late summer C exchange rates are dependent upon previous winter conditions. Our study indicates that surface processes in the High Arctic are sensitive to winter snow depth and that changes in physical, chemical and biological processes alter the magnitude and patterns of feedbacks between High Arctic landscapes and the arctic atmosphere.

140. State of Permafrost in Alaska

Vladimir Romanovsky, Sergey Marchenko, Dmitri Sergeev, Dmitri Nicolsky, Ronald Daanen

Permafrost temperatures were on the rise during the last 20 years in Alaska. Generally, an increase in permafrost temperatures in Alaska during the last two decades was more pronounced at the coastal Arctic sites (from 1.5 to 3.0°C at the permafrost table) and less pronounced in the Interior Alaska (from 0.5 to 1.5°C). This increase in permafrost temperatures was not monotonous. During the observational period, relative cooling occurred in the early 1990s (late 1980s in the Interior Alaska) and then again in the early 2000s. Surprisingly warm ground and permafrost surface temperatures were observed in western part of the northern foothills of the Brooks Range. During the last two years, the mean annual temperature at the ground surface at the coldest Ivotuk site (we have four sites there) was warmer

than 1°C. Mean annual temperature at the permafrost surface (at 0.7 m depth) was warmer than 2.5°C, that at least 2°C warmer than was observed by US Geological Survey in the early 1980s (the Lisburne #1 borehole).

Unlike the permafrost temperatures, data on changes in the active layer thickness in Alaska are less conclusive. While some of the sites show a slightly noticeable increasing trend, most of them do not. The active layer was especially deep in 2005 in Interior Alaska. At many sites, the active layer developed during the summer of 2004 (one of the warmest summers in Fairbanks on record) and did not completely freeze during the 2004-2005 winter.

At some locations within the discontinuous permafrost of the Alaska interior, permafrost is presently thawing in natural undisturbed conditions. Deepening of the permafrost table from 3.5 m in 1989 to 5 m in 2004 was observed within some areas at the Gakona Permafrost Observatory in central Alaska. However, a more common cause of the long-term thawing of permafrost is the disturbances of the ground surface above the permafrost, both natural (forest fire, flood) and human-made (agricultural activities, roads and building constructions, etc).

141. Monitoring and Modeling of the Northern Eurasia Permafrost Dynamics

Vladimir Romanovsky, Sergey Marchenko, Claude Duguay, Mikhail Zheleznyak, Dmitri Sergeev

Permafrost has received much attention recently because surface temperatures are rising in most permafrost areas of the earth, bringing permafrost to the edge of widespread thawing and degradation. The thawing of permafrost that already occurs at the southern limits of the permafrost zone can generate dramatic changes in ecosystems and in infrastructure performance. As a part of IPY-related activities, we are starting a three-year project in Northern Eurasia sponsored by NASA. This project will be primarily focused on addressing the climate and hydrological aspects of the NEESPI program (Northern Eurasia Earth Science Partnership Initiative). It also reflects very well the goals of the Study of Environmental Arctic Change (SEARCH) program in detecting and elucidating the recent changes in the Arctic and their impacts on human lives and activities here.

Observational data will be used in conjunction with a two-tiered modeling approach to simulate present, past and future permafrost conditions in the Northern Eurasia permafrost region. The observational data will consist of subsurface and surface data, together with relevant atmospheric and remote sensing data, for the entire Northern Eurasia permafrost domain. A significant portion of the permafrost data will be obtained within a framework of the IPY-core Thermal State of Permafrost (TSP) project. These data will be incorporated into a Geographical Information System (GIS) for spatially distributed permafrost models and for interpretation, synthesis and integration of observational and modeled results. Two tiers of model simulations will include (1) simulations for specific sites with maximum available information for calibration and validation, (2) spatially distributed simulations for the entire Northern Eurasia permafrost region using the improved GIPL model developed at the Permafrost Lab, University of Alaska Fairbanks. Simulations will be both retrospective (spanning the 20th century) and prognostic (spanning the 21st century). Synthesis and integration activities will be achieved through the utilization of soil and atmospheric data from a wide range of sources (including IPY/TSP project) in Northern Eurasia and by comparisons of present (measured) and simulated characteristics of the active layer and permafrost dynamics within the Northern Eurasia permafrost region. The project will include diagnosis and interpretation of the causes of observed permafrost variations. Mapping of the areas of potential permafrost degradation will be possible from the simulations for the entire Northern Eurasia permafrost domain.

142. Genetic Diversity and Population Structure of Moose in Alaska

Jennifer Schmidt, Kevin McCracken, Kris Hundertmark, Terry Bowyer

Moose (*Alces alces*) are highly mobile and inhabit an extensive range in Alaska with a prominent influence on the ecosystem. We examined the genetic diversity and population structure of moose ($n = 121$) with 7 polymorphic microsatellites from 5 regions within Alaska. Also of interest was potential for evidence of bottlenecks, male-bias dispersal, and isolation by distance. Genetic diversity and heterozygosity were both generally higher in samples found in Interior Alaska ranging from 0.660 to 0.529 and from 0.603 to 0.538, respectively. Both F_{st} and R_{st} indicated significant population structure ($P < 0.001$), however population differentiation could not be determined between the Tanana Flats and Koyukuk regions in Interior Alaska or between Koyukuk and Seward Peninsula. Overall, F_{st} values were not very large ($F_{st} < 0.15$) and dependent on the method used, results from the program STRUCTURE indicated either one or 5 populations. In addition, moose from the Tanana Flats and Alaska Peninsula have experienced a bottleneck but moose as a whole in Alaska have not. Males had larger F_{is} and usually greatly gene diversity which supports male-

bias dispersal. Finally, our analysis suggests isolation by distance could partially explain observed genetic structure ($r = 0.66$, $P = 0.0041$).

143. GPS Time Series According to Earth Time

Therese Schneek

A quarter of the Ice-Sheet growth is caused by global warming in Greenland. The most substantial thinning is observed over outlet glacier(*). The Icelandic low shifted southwestward in Cape Farewell in 1996. The changes observed are associated with a record positive-to-negative NAO index reversal (-20cm NAO value in 1996 and 2004). The GPS time series was 12 seconds minus UTC time in 1996 and 10 seconds in 2004 according to the present femtosecond accuracy of clocks. Since 1900 there were only 62 leaps seconds added in time. The GPS time series accuracy is a threat to Earth rotational changes and time set to UTC time and earth time.

144. The Modulation of Metabolism by Nitric Oxide (NO)

Tara Scribner, Barbara Taylor, Michael Harris

Aerobic cellular metabolism is depressed when oxygen availability is low (hypoxia). This appears to be a regulated process that reduces oxygen demand to prevent or delay cell damage, but the mechanisms responsible for this response are poorly understood. Nitric oxide (NO) is a gaseous transmitter involved in regulation of physiological and pathological functions of many tissues. It is a potential modulator of many cellular processes, including metabolism, although the mechanisms of this regulation are also poorly understood. The synthesis of NO is critically dependant on O₂ and is compromised by hypoxia. Our experiments were designed to determine if NO can regulate cellular metabolism, as demonstrated by changes in the cellular oxygen consumption of isolated liver cells in response to exogenous application of NO or manipulation of endogenous NO synthesis. We used cellular respirometry to test the hypotheses that NO, applied from an exogenous source or through enhanced endogenous synthesis, will stimulate metabolism, while disruption of endogenous NO synthesis will inhibit metabolism. We have tested the influence of the exogenous NO-donor Sodium Nitroprusside (SNP; 1-20 mM) and have identified that application of 10 mM SNP appears to induce an approximately 30% increase in cellular oxygen consumption. These data indicate that metabolism can be modulated by NO. Studies involving manipulation of endogenous NO synthesis are ongoing and current results will be discussed.

This research is supported by an Undergraduate Student Project Award from Alaska INBRE.

145. Carbonate Chemistry Dynamics and Carbon Dioxide Fluxes across the Atmosphere-Ice-Water Interfaces in the Arctic Ocean: Pacific Sector of the Arctic.

Igor Semiletov, Natalia Shakhova, Irina Pipko, Irina Repina

Climatic changes in the Northern Hemisphere have led to remarkable environmental changes in the Arctic Ocean, which is surrounded by permafrost. These changes include significant shrinking of sea-ice cover in summer, increased time between sea-ice break-up and freeze-up, and Arctic surface water freshening and warming associated with melting sea-ice, thawing permafrost, and increased runoff. These changes are commonly attributed to the greenhouse effect resulting from increased atmospheric carbon dioxide (CO₂) concentration and other non- CO₂ radiatively active gases (methane, nitrous oxide). The greenhouse effect should be most pronounced in the Arctic where the largest air CO₂ concentrations and winter-summer variations in the world for a clean background environment were detected. However, the air-land-shelf interaction in the Arctic has a substantial impact on the composition of the overlying atmosphere; as the permafrost thaws, a significant amount of old terrestrial carbon becomes available for biogeochemical cycling and oxidation to CO₂. The Arctic Ocean's role in determining regional CO₂ balance has been ignored, because of its small size (only ~4% of the world ocean area) and because its continuous sea-ice cover is considered to impede gaseous exchange with the atmosphere so efficiently that no global climate models include CO₂ exchange over sea-ice. In this paper we show that: 1) the arctic shelf seas (the Laptev and East-Siberian seas) may become a strong source of atmospheric CO₂ because of oxidation of bio-available eroded terrestrial carbon and river transport; 2) the Chukchi Sea shelf exhibits the strong uptake of atmospheric CO₂; 3) the sea-ice melt ponds and open brine channels form an important spring/summer air CO₂ sink that also must be included in any Arctic regional CO₂ budget. Both the direction and amount of CO₂ transfer between air and sea during open water season may be different from transfer during

freezing and thawing, or during winter when CO₂ accumulates beneath Arctic sea-ice; 4) direct measurements beneath the sea ice gave two initial results. First, a drastic pCO₂ decrease from 410 μ atm to 288 μ atm, which was recorded in February-March beneath the fast ice near Barrow using the SAMI-CO₂ sensor, may reflect increased photosynthetic activity beneath sea-ice just after polar sunrise. Second, new measurements made in summer 2005 beneath the sea ice in the Central Basin show relatively high values of pCO₂ ranging between 425 μ atm and 475 μ atm, values, which are larger than the mean atmospheric value in the Arctic in summertime. The sources of those high values are supposed to be: high rates of bacterial respiration, import of the Upper Halocline Water (UHW) from the Chukchi Sea (CS) where values of pCO₂ range between 400-600 μ atm, a contribution from the Lena river plume, or any combination of these sources.

146. Methane Anomalies in the Arctic Siberia: Land-Shelf and Air-Sea Systems

Natalia Shakhova, Igor Semiletov

In this paper we present three years of data obtained during the late summer period (September 2003, September 2004, and September 2005) for the East Siberian Arctic shelf (ESAS). According to our data, the surface layer of shelf water was supersaturated up to 2500% relative to the present average atmospheric methane content of 1.85 ppm, pointing to the rivers as a strong source of dissolved methane which comes from watersheds which are underlain with permafrost. Anomalously high concentrations (up to 154 nM or 4400% supersaturation) of dissolved methane in the bottom layer of shelf water at a few sites suggest that the bottom layer is somehow affected by near-bottom sources. The net flux of methane from this area of the East Siberian Arctic shelf can reach up to 13.7×10^4 g CH₄ km⁻² from plume areas during the period of ice free water, and thus is in the upper range of the estimated global marine methane release. Ongoing environmental change might affect the methane marine cycle since significant changes in the thermal regime of bottom sediments within a few sites were registered. Correlation between calculated methane storage within the water column and both integrated salinity values ($r=0.61$) and integrated values of dissolved inorganic carbon (DIC) ($r=0.62$) suggest that higher concentrations of dissolved methane were mostly derived from the marine environment, likely due to in-situ production or release from decaying submarine gas hydrates deposits. The calculated late summer potential methane emissions tend to vary from year to year, reflecting most likely the effect of changing hydrological and meteorological conditions (temperature, wind) on the ESAS rather than riverine export of dissolved methane. We point out additional sources of methane in this region such as submarine taliks, ice-complex retreat, submarine permafrost itself and decaying gas hydrates deposits. The role of Great Siberian Rivers in the methane lateral transport is also discussed.

147. An Overview of Long-Term Climate Variability and Change in Alaska

Martha Shulski, Gerd Wendler

Long-term climatological data for Alaska exist for about a century. Data were obtained for locations representing the main climate regions found in the state: arctic, continental, and maritime. Temperature data from Barrow, Nome, Fairbanks, Matanuska Agricultural Experiment Station, and Sitka illustrate the importance considering short and long-term variability when looking at trends. The stations show a total increase in mean annual temperature on the order of 0.7 $^{\circ}$ C to 1.3 $^{\circ}$ C going back to the early 20th century. Sitka is an exception with a slight decrease in temperature since 1900. In addition to a general warming, these data show high interannual variability superimposed on longer-term decadal scale variability. Some stations show dramatic shifts over short time periods with changes from predominantly below normal to above normal temperatures, and vice versa. This pattern of variability is realized on the seasonal scale as well, most prominently in winter. The shifts appear around 1945 and 1976 and are coincident with changes in the Pacific Decadal Oscillation (PDO), a pattern of variability in Pacific climate. Above normal temperatures prior to 1945 were followed by a cool period until 1976 and temperatures again shifted to positive anomalies. In comparison to the total change over the last 100 years, the temperature trends for the last five decades shows a warming of about 1.9 $^{\circ}$ C. Therefore the shorter-term change cannot be extrapolated back to the beginning of the 20th century. Since 1976 most stations in Alaska show a slight warming of about 0.5 $^{\circ}$ C. A noted exception is for Barrow, which has shown a fairly steady temperature increase since the mid 1970s. Given the observed multi-decadal variability in the historical data, future temperature patterns in Alaska may strongly depend on the phase of climate signals such as the PDO and others.

On average the earth has warmed approximately 0.6 $^{\circ}$ C over the last 100 years and observed changes have been greatest during the winter than any other season. Global climate models (GCMs) predict further warming through the

end of the 21st century; however, the magnitude varies by scenario and across the models. Regions in the Arctic are predicted to warm more than the global average, from about 3Â°C to 7Â°C by the end of this century, with the strongest warming predicted for the cold seasons. One aspect in which the models have had shortcomings, however, is in the simulation of historical climate with capturing the long-term variability in the temperature records. An example of this is the cooling in the 1940s and 50s coincident with a CO₂ increase. As historical data for Alaska show, the long-term variability is an important characteristic of the climate and significantly impacts the determination of trends.

148. Will Permafrost Thaw Trigger a Loss of Arctic lakes?

Laurence Smith, Yongwei Sheng

Lakes, ponds and wetlands play a preeminent role in the high-latitude terrestrial hydrologic cycle, owing to their near-ubiquitous presence across low-relief northern landscapes. Despite the fact that much of the Arctic is semi-arid in terms of precipitation, low evapotranspiration and a prevalence of low-relief lowlands, poorly organized drainage pattern, and low-permeability substrates enable the world's highest abundance of lakes northwards of ~60° N latitude, profoundly influencing the region's ecology, hydrology, energy balance and exchange of trace gases with the atmosphere. A number of recent "change-detection" studies suggest that the spatial distribution of Arctic lakes is rapidly transforming, with lake expansion in some areas (especially continuous permafrost) but shrinkage or disappearance in others. Our own change-detection study of ~10,000 Siberian lakes over a large geographic area (~515,000 km²) identified both phenomena, with lake increases in continuous permafrost but decreases further south since 1973 (Smith et al., 2005). A proposed mechanism explaining both phenomena is permafrost thaw, i.e. (1) in continuous permafrost, an initial phase of lake expansion associated with thermokarst development, followed by (2) lake shrinkage and eventual drainage as the permafrost degrades still further, enhancing infiltration to the subsurface (perhaps through taliks that fully penetrate permafrost). To test such ideas at the broadest possible spatial scale, the locations of ~200,000 large northern hemisphere lakes (sized 0.1 to 50 km², northwards of ~45° N latitude) are intersected with new global databases on topography, permafrost, peatlands, and LGM glaciation to identify some first-order controls on lake abundance and land area fraction at the pan-Arctic scale. On average, lake density (abundance per unit area) in glaciated terrain is more than four times that of non-glaciated terrain, and is nearly ten times greater in permafrost. By far the lowest prevalence of lakes occurs in unglaciated, permafrost-free terrain. In all areas, the presence of permafrost appears to roughly double the density and area fraction of lakes, and further increases of ~40-80% are associated with peatlands. Lake densities and area fractions are generally similar across continuous, discontinuous and sporadic permafrost zones, decrease slightly in isolated permafrost, and drop sharply in the absence of permafrost. A simple calculation based on "space-for-time" substitution in glaciated/lowland terrain (~2.7 X 10⁷ km², of which ~48% is currently in some state of permafrost) suggests that in a permafrost-free Arctic, this population of lakes would be reduced from 191,583 to 102,844 (-46%) and total inundation area would be reduced from 560,205 to 324,812 km² (-42%). Within current permafrost only (~1.3 X 10⁷ km²), such losses would represent a ~63% reduction in lake abundance.

149. Exploring Local Capacities and Strategies to Manage Rainfall Variability and Drought - A Case of the Semi-Arid Areas in Makueni District, Kenya

Chinwe Ifejika Speranza, Urs Wiesmann, Boniface Kiteme

This paper argues that the capacity of local African actors to deal with dynamic 'every-day normal' conditions, first needs to be analysed before assessing their capacity to cope with and adapt to particular stressors like drought. Such an approach highlights the underlying factors that determine capacities and provides a solid fundament for exploring pathways to strengthening the resilience of rural African communities to adverse effects of climate variability and global environment change. This paper investigates why drought, an expected event, continues to destabilise local livelihoods and how the resilience of local communities to drought can be strengthened. The analysis is based on data from fieldwork in the agro-pastoral semi-arid areas of Makueni District, Eastern Kenya, comprising household surveys, interviews with various stakeholders, group discussions, workshops, and analysis of rainfall data. Firstly, the local conditions and their effects on local capacities to deal with rainfall variability and drought are examined. Secondly, the actions and strategies of the actors within the framework conditions are analysed. Thirdly, the interrelations between the various factors and their implications for shaping the adaptive capacity and resilience of local actors are highlighted. Results show that biophysical, socio-economic, cultural, and political conditions constrain rural livelihoods. At the same time the agro-pastoral households themselves do not have adequate capacities to utilise the few available potentials offered by their environment. The interplay of constraining conditions and inadequate agro-pastoral capacities indicates that there is need to invest in basic infrastructure like water, roads, health and education as leverages from which

local actors can act more effectively to maintain their livelihoods security in the face of climate variability and global environment change. A change in perceptions, the intensification of policy dialogue and effective policy implementations are crucial to achieving these developments.

150. Hybridization in Beringia: Allotetraploid origin of *Arabidopsis Lyrata* Subsp. *Kamchatica*

Janette Steets, Dane Salter, Jessica Beecher, Gary Houlston, Naoki Takebayashi

The arctic flora has been shaped through numerous large-scale climatic and physical changes due to glaciations. Stebbins (1984) suggested that polyploidization (genomic duplication) may have been an important evolutionary force of plants from such glaciated area. Here, we aim to understand the origins of an arctic plant species, *Arabidopsis lyrata* subsp. *kamchatica*, a close relative of the model plant *A. thaliana*. Through the use of flow cytometry, we determine that *A. l. kamchatica* is a tetraploid throughout the species range. We inferred the origins of this tetraploid species using DNA sequences from three nuclear genes, Chalcone Synthase (CHS), Cytosolic Phosphoglucose Isomerase (PGIC2), and Short-Chain Alcohol Dehydrogenase (SCADH). Fixed heterozygosity in all gene sequences indicates *A. l. kamchatica* is an allotetraploid. All gene genealogies were congruent with one another and indicate that *A. l. kamchatica* likely originated from hybridization between two closely related species, *A. l. petraea* and *A. halleri gemmifera*. Further, all seven populations of *A. l. kamchatica* examined were nearly identical in gene sequences suggesting a single origin of this species. Our findings open the door for detailed examinations of genetic consequences after a large-scale genomic duplication using a species closely related to a model organism.

151. Chemical Validation of a Dual Energy X-ray Absorptiometry (DXA) Apparatus for Determining Body Condition in Free-Living and Lab-Raised Voles.

Kalb Stevenson, Ian Van Tets

Dual energy X-ray absorptiometry (DXA) is a non-destructive technique for measuring the body condition of animals which must be chemically validated to ensure the precision and accuracy of its measurements. We used proximate analysis to validate measurements of a DXA apparatus in whole-bodied free-living and lab-raised northern redbacked voles (*Clethrionomys rutilus*). We derived algorithms that rely upon DXA measurements of fat mass (FM), lean mass (LM), and bone mineral density (BMC) to predict actual values of total protein, lean mass (LM), total body mineral content (TBMC), non-bone mineral content (NBMC), fat-free mass (FFM), and total body mass of voles. We also provide corrective equations for PIT-tagged voles. FMDXA measurements generally had high variability, while LMDXA and BMCDXA measurements had low variability. When the two heaviest lab-raised animals (each weighing over 30g) were removed from statistical analyses, the amount of unexplained error in some of our predictive models decreased, suggesting an upper boundary on the capabilities of the DXA apparatus. Most notably, FM determined chemically was strongly correlated to FMDXA for lab-raised voles ($FM_{CHEM} = 1.23FMDXA - 0.61$, $R^2 = 0.93$) and for all voles grouped collectively ($FM_{CHEM} = 1.43FMDXA - 1.69$, $R^2 = 0.94$), but not for the leaner free-living voles ($R^2 = 0.28$). To predict actual FM in free-living voles with good precision and accuracy using DXA measurements, the strong relationships between fat-free mass derived by DXA ($FFMDXA = LMDXA + BMCDXA + \text{non-bone mineral content}$) and fat-free mass derived chemically ($FFM_{CHEM} = LM_{CHEM} + TBMC$) for free-living voles ($FFM = 0.99(FFMDXA) - 0.25$, $R^2 = 0.99$), for lab-raised voles ($FFM = 1.03(FFMDXA) - 1.47$, $R^2 = 0.97$), and for all voles collectively ($FFM = 0.98(FFMDXA) - 0.34$, $R^2 = 0.99$) enable an accurate calculation of FM difference ($FMDIFF = \text{Body Mass} - FFMDXA$). Our validation of a DXA apparatus on whole-bodied free-living and lab-raised voles provides a non-destructive tool of body condition measurement in small rodents with excellent precision and accuracy and offers broad application for physiological ecology and wildlife management studies.

152. Identifying Photosynthetic Efficiency in Arctic Phytoplankton and Sea Ice Algae Under Environmental Stress Using Pam Fluorometry

Sarah Story, Rolf Gradinger

This study investigates the photophysiological response of phytoplankton and sea ice algae communities to environmental parameters (e.g. salinity, nutrient dynamics, temperature, and light). In situ incubations of whole ice cores were deployed twice for 5 day periods each, in the fast ice cover near Barrow, Alaska in 2005. Photosynthetic efficiency (F_v/F_m) was measured using Pulse Amplitude (PAM) Fluorometry. Incubations were done using three different nutrient and two light regimes. Non-incubated ice samples were taken for daily and seasonal F_v/F_m variability. Ice PAM measurements were

done using brine collected from four ice sections taken from the bottom 20 cm of the ice cores by centrifugation. Small-scale spatial variability (in percents) of Fv/Fm in March, May and Dec was 2-9, 1-8 and 10-18 respectively, based on 3 replicates taken at each location. Fv/Fm of water column varied (in percents) in May and December by 13-31 and 36 respectively. Fv/Fm in treated cores were 20 to 30 percent lower than in reference cores. Natural ice algal assemblages exhibited notable daily cycles in the photosynthetic yield parameter.

153. Microtopographic Controls on Carbon Exchange in a High Arctic Fen

Paddy Sullivan, Seth Arens, Rod Chimner, Jeffrey Welker

Relatively few studies have examined carbon cycling in the High Arctic. Fewer still have investigated the carbon balance of high arctic wetlands, which are "hot-spots" for land-atmosphere CO₂ exchange in the high arctic landscape. This study was designed to fill gaps in our understanding of carbon cycling in northern wetlands, with an emphasis on the role of microtopography as a mediator of CO₂ fluxes.

Measurements of plot-level CO₂ exchange were made every other week during three growing seasons in a fen near Pituffik, Greenland. Rates of CO₂ assimilation and CO₂ release were significantly higher in hummocks, which extend above the water table, than in pools, where the water table lies above the soil surface. Net CO₂ exchange was similar when hummocks and pools were compared, despite rates of plant production that were 5-times higher in hummocks than in pools.

Our observations highlight the potential for decoupling of plant production and C storage in the High Arctic and suggest that areas of low plant production, but proportionately lower rates of microbial respiration, may be important to contemporary and historical C storage in the High Arctic.

154. North Slope Science Initiative – Managing Oil and Gas Development through Science on Alaska's North Slope

Kenton Taylor, Josh Payne

The North Slope of Alaska is a vast area of the polar arctic encompassing 233,500 square kilometers. This region supports a variety of important fish and wildlife populations, including polar bears, nesting habitat for hundreds of thousands of waterfowl, shore birds and other avian species. Offshore areas provide habitat for a variety of marine mammals, including ringed and bearded seals, walrus and bowhead whales, and four caribou herds numbering more than 600,000 animals. All of these resources are of vital importance both nationally and to the residents of the North Slope who depend on them for subsistence.

Model components of the NPR-A Research and Monitoring Team established by the Bureau of Land Management, the North Pacific Research Board, and the Exxon/Valdez Trustee Council were evaluated and incorporated into the NSSI structure. Formalized in the Energy Policy Act of 2005, the NSSI is composed of the land and resource management agencies at the local, state and federal level. Agency heads in Alaska comprise the NSSI Oversight Group. In addition, the U.S. Arctic Research Commission and U.S. Department of Energy serve as advisors. The Oversight Group is also advised by a Science Technical Group established by the Secretary of the Interior.

The NSSI mission is to enhance the quality and quantity of the scientific information available for aquatic, terrestrial and marine environments on the North Slope and to make this information available to decision-makers, governmental agencies, industry and the public. This mission will be accomplished through a coordinated and integrated approach to conducting inventory, monitoring and research activities on the North Slope.

Priority objectives of this organization are to:

- Identify and prioritize information needs for inventory, monitoring and research activities to address impacts of past, ongoing and anticipated development activities on the North Slope;
- Coordinate ongoing and future inventory, monitoring and research activities to minimize duplication of effort, share financial resources and expertise, and assure the collection of quality information.

Funding for the NSSI is expected in the FY2007 federal budget to address priority needs which include baseline hydrologic and water quality information, effects of disturbance on subsistence resources, developing a project database

to facilitate collaboration, and developing a North Slope data management system.

155. Shifts in Mycorrhizal Fungi Communities in Arctic Tundra Ecosystems along a Bioclimatic Gradient

Ina Timling, Lee Taylor, Donald Walker, Gary Laursen

Fungi are ubiquitous key components of terrestrial ecosystems that drive mineral and energy cycling, and influence the occurrence of other organisms. The two most prominent functional groups of fungi in soils are saprophytic decomposer fungi and mycorrhizal fungi which form a symbiosis with the majority of plants. However, the abundance, diversity, functions and potential responses to climate change of these fungal groups in the Arctic tundra are not fully understood. Therefore, the goal of our project is to investigate how shifts of mycorrhizal fungi communities correlate with changes in plant communities and abiotic factors along a bioclimatic gradient from the low Arctic to the Polar desert. The research is being conducted at recently established and described sites of the North American Arctic Transect (NAAT). Our objective was to collect roots from individual plant species of the present communities, soils and fungal fruiting bodies. Fungal diversity is assessed by the application of molecular methods. These processes entail extraction of DNA, amplification of ribosomal RNA genes with fungal specific primers and the establishment of fungal clone libraries. Each clone library is being sequenced. The sequences obtained contribute to the database of Arctic fungi currently being established through ongoing research in the 'Fungal Metagenomics Project' at the University of Alaska Fairbanks (<http://iab-devel.arsc.edu/metagenomics/>). Preliminary data show a reduction in fungal diversity in roots and fungal fruiting bodies with increasing latitude, as well as a decline of ectomycorrhizal morphotypes obtained from *Salix arctica*.

156. Adapting to Change: Cases of Detached, Dependent, and Sustained Community Development in Greenland

Daniela Tommasini, Rasmus Rasmussen

During the 20th century in Greenland three major socio-economic shifts have occurred. All of them, described as social adjustments to world realities, have been induced by the interactions between the natural systems, the climate change, the socio-economic and socio-technical system of resource exploitation. The first shift, from a sea mammal based economy to fisheries, occurred during the 1910-20's. Mainly due to a marked increase in sea temperature, this shift resulted in a decrease in the sea mammal stock, combined with a declining world market for blubber and sealskin, and as result cod became the dominating species. The second important shift occurred during the 1980's, due to a reduction in sea temperature, moving from cod fisheries to a substantial development of shrimp fisheries, especially facilitated by a shift from inshore to offshore fisheries, that created a mono economy based on shrimps. And the third is the ongoing shift towards a more diversified focus of fisheries, with shrimp as the backbone of the economy, but with Greenland Halibut offering substantial contributions in the Northern Regions.

Even the pattern of changes in resource base has been more or less similar all over Greenland, the socio-economic changes have been remarkable varied, and the poster illustrates three characteristic patterns. Sisimiut, presently the second largest settlement in Greenland, has been characterized by its ability to adjust positively to the changes, showing initiative, innovativeness, and adequate social capital. The community shows all signs of self-sustaining dynamic. Paamiut, on the other hand, was able to adjust to the first transformation process to fisheries, and was chosen by the authorities as a model for the modernized industrial processing of renewable resources. With the changes in Resources the highly centralized decision structures were not able to adjust to the changes, eventually leading to a decay of as well as economy as society. The case illustrates a typical example of a dependent development dynamics. Tasiilaq, and East Greenland in general, shows a third approach to respond to changes. Several attempts have been made from the authorities to involve the community in the development process, but generally without any enduring success, partly due to some differences in resource characteristics between the East and West Coast of Greenland, and partly due to the long duration of semi-colonial relationships both to Denmark and to the West Greenland. This case illustrates the characteristics of a detached development dynamics.

157. Activation of 5HT_{1A} Receptors with 8-OH-DPAT Does not Prevent Gasping but May Impair Auto-Resuscitation

Veronica Toppin, Anna Kober, George Richerson, Walter St. John, Michael Harris

Medullary neurons that contain serotonin (5HT) are involved in multiple homeostatic functions including regulation of ventilation. Serotonergic dysfunction has been proposed as a causative factor to the Sudden Infant Death Syndrome (SIDS) and it has been suggested that SIDS could result from a failure of auto-resuscitative gasping. We tested the hypothesis that 5HT neurons are critical for auto-resuscitation by investigating the contribution of serotonin neurons to the genesis of gasp-like phrenic nerve motor patterns induced by ischaemia, and the return of eupneic phrenic motor patterns with reperfusion, in the perfused juvenile rat working heart-brainstem preparation. Serotonergic influences were assessed by determining the impact of 5HT neuron inhibition via the addition of a specific 5HT_{1A} receptor agonist, 8-hydroxy-(dipropylamino) tetralin hydrobromide (8-OH-DPAT), into the perfusate (0, 1.5, 3 and 6 μ M). Gasp-like burst patterns were induced by ischemia, and eupneic patterns returned with reperfusion, despite 8-OH-DPAT treatments. As this treatment is assumed to cause inhibition of 5HT neurons via autoreceptor activation, we conclude that 5HT mechanisms may not be critical for the genesis of gasping per se, although instability of eupneic burst patterns following reperfusion suggests that successful auto-resuscitation could be compromised by serotonergic dysfunction.

This research was supported by the NIH, NINDS Office of Minority Health Research SNRP program, the Alaska IDEa Network of Biomedical Research Excellence, and the NSF Alaska Experimental Program to Stimulate Competitive Research.

158. Human-Fire Interactions in the Boreal Forest of Alaska

Sarah Trainor, F. Stuart Chapin III, Michele Bifelt, Monika Calef, La'ona DeWilde

Human-ecological interactions are increasingly recognized as a central feature of the dynamics of systems that have been traditionally studied separately by ecologists and social scientists. In Interior Alaska these human-environment interactions are particularly striking because (1) this region has been occupied by Athabascan Indians who maintain a cultural and nutritional connection to the land that extends back for thousands of years, and (2) this human-ecological interaction is rapidly changing due to global human impacts on climate, economics and culture. In this paper we summarize the approach, methods, and results of an interdisciplinary study of human-fire interactions in Interior Alaska. Because the physical effects of climate warming disproportionately impact northern latitudes, increases in wildfire frequency, severity, duration and total area burned are among the most significant recent and expected ecological impacts of climate change. Given these changes, we describe how humans have impacted the fire regime of Alaska. We also discuss wildfire effects on social and economic systems in the boreal forest and the options that communities and resource management agencies have to plan for resilience in the face of these social, ecological and climatic changes.

Key outcomes of this interdisciplinary project that are relevant to the overall study of coupled social-ecological systems include: 1) the adaptation and application of qualitative archival data as inputs for a spatially explicit vegetation succession model (ALFRESCO); 2) the discovery of temporal and spatial variance in key variables and drivers of the social – ecological system and; 3) the analysis of the importance of cross-scale interactions in planning for social – ecological resilience in the face of directional change.

159. Rapid Glacier Change

Martin Truffer

In recent years several of the outlet glaciers in Southern Greenland have accelerated, thinned and retreated dramatically in a pattern that is very reminiscent of rapid tidewater glacier retreat, as it has been observed in Alaska. The impact of these changes on the Greenland ice sheet is still unclear. In a current project we are investigating the inland propagation of these changes at Jakobshavns Glacier in Greenland, using measurements on the ground as well as remote sensing. Several IPY projects that are currently in review also address the theme of dynamical changes in glaciers. I will present three projects: 1) a study of Alaskan tidewater glaciers under the international initiative GLACIODYN, 2) a study of glacier speed-up behind disintegrating ice shelves on the Antarctic Peninsula, and 3) a process study of basal melting near the grounding line of Pine Island Glacier, West Antarctica. In all projects we are investigating changes that are initiated near the ocean and propagate upglacier or into an ice sheet. Rapid propagation of such changes can have

large effects on global sea level rise.

160. Evaluation of Net Ecosystem Productivity Over Alaska Black Spruce Forests Based on Satellite Remote Sensing

Masahito Ueyama, Yoshinobu Harazono

We evaluated gross primary production (GPP), net ecosystem productivity (NPP), and autotrophic respiration over Alaska black spruce forests by combining a field-observed dataset and a newly developed satellite-based model. A three-year continuous dataset derived from the eddy covariance technique at a black spruce forest was used to link the MODIS products of NDVI and land surface temperature (LST) to the tower-based GPP. In order to determine NPP and autotrophic respiration (RES), BIOME-BGC was tuned and validated for Alaska black spruce forests. Using simulation results from a sensitivity analysis, ratios, NPP/GPP and RES/GPP, were determined as functions of LST, and then applied to calculate NPP and RES.

The model satisfactorily reproduced not only the tower-based GPP but also simulated NPP and autotrophic respiration by BIOME-BGC. The spatial distributions of the carbon fluxes showed weak longitudinal trends with relatively lower values in the eastern interior around the Brooks Range. The estimated GPP, NPP, and autotrophic respiration over Alaska black spruce forests were 1840, 590, and 1250 g CO₂ m⁻² y⁻¹, respectively, between 2003 and 2005.

161. The Role of Nitric Oxide in Regulating Mitochondrial Density in the Cardiac Muscle of Antarctic Fish

Matthew Urschel, Kristin O'Brien

Antarctic icefishes (family Channichthyidae) lack the oxygen-carrying protein hemoglobin (Hb), and some members of this family also lack the intracellular oxygen-binding protein, myoglobin (Mb) in cardiac muscle. One interesting adaptation to the loss of Hb and/or Mb is an increase in mitochondrial density in oxidative muscle. Recent studies have shown that Hb and Mb not only bind oxygen, but also function as nitric oxide (NO) scavengers, converting NO to nitrate (NO₃⁻). In addition, separate studies have shown that mitochondrial biogenesis is stimulated by NO which induces the expression of the transcriptional coactivator, peroxisome proliferator-activated receptor coactivator (PGC). PGC activates the transcription of many genes involved in oxidative phosphorylation (OXPHOS), and is often referred to as the "master regulator" of mitochondrial biogenesis. We hypothesize that the loss of Hb and Mb in icefishes leads to an increase in NO, resulting in the upregulation of genes involved in mitochondrial biogenesis. We are testing this hypothesis by quantifying the levels of expression of several key genes involved in mitochondrial biogenesis in the hearts of three closely-related species of Antarctic fish that vary in their expression of Hb and Mb. *Notothenia coriiceps* expresses both Hb and Mb. *Chionodraco rastrospinosus* and *Chaenocephalus aceratus* both lack Hb, but *C. rastrospinosus* expresses Mb in cardiac muscle, whereas *C. aceratus* does not. The level of expression of PGC, nuclear respiratory factor-1 (NRF-1) and mitochondrial transcription factor A (mtTFA) will be quantified in the cardiac muscle of these fish.

162. Recent and Projected Future Changes in the Behavior of Arctic Clouds

Steve Vavrus

Clouds are known to be one of the most important elements of the Arctic climate system, strongly reducing wintertime cooling and summertime heating. Cloud coverage thus has a strong influence on surface temperature, snow melt, and sea ice volume. During the past two decades, polar cloudiness and cloud properties have shown interesting behavior that begs further investigation. During winter, Arctic cloud coverage has decreased significantly, while springtime cloudiness has increased in association with greater cloud liquid water and optical depth. These variations seem to be related to changes in atmospheric circulation and sea ice, suggesting that ice cover may interact closely with clouds and that anticipated future losses of sea ice may be important for the response of high-latitude clouds.

A suite of global climate models (GCMs) has been analyzed with respect to simulations of recent past and projected future cloudiness. None of the models is able to reproduce both the observed decrease in wintertime Arctic cloudiness and the increasing trend in springtime cloud cover during recent decades. In addition, none of the GCMs produces enough decadal variability in polar cloud amount to match the magnitude of observed trends, regardless of the sign.

Models are in better agreement as to future changes in Arctic clouds, generally projecting greater cloud cover (especially low cloudiness) as greenhouse warming takes hold during this century. We speculate that the simulated relationship between climatic warming and increased cloud amount is caused by greater moisture availability, due to enhanced poleward water vapor transport in the moister global atmosphere and expanded areas of open water within the Arctic Ocean as the ice pack shrinks. These changes should result in clouds that are more liquid in composition and optically thicker than at present. Depending on how these changes vary seasonally, such altered cloud properties may significantly mitigate future Arctic warming or add to the numerous positive feedbacks within the polar climate system.

163. Evaluating the Use of *Cementum Annuli* to Identify Maturity in Sea Otters

Vanessa Von Biela, Jennifer Burns

Across the continent are indigenous peoples who are connected the land and nature. It is through their voices that nature can speak. They are the care takers of the land. The wisdom keepers or spiritual leaders tell us that the path of Western technology is separated from the natural and spiritual law which is creating chaos.

While many Westerners maintain respect for the wisdom of the Elders and caretakers of the land, some view this knowledge as dead and useless. On the other hand, many Native people have not abandoned the ancient wisdom from the past, which comes from the ancestors through the Elders. The caretakers of the land have an instinctual desire to protect the earth. They live in harmony with nature and ancestral wisdom.

Alaska Native people are observing changes in their day to day lives and are expressing concern over the sudden variation of climate conditions and the unpredictability of the weather. There has been a critical impact on the traditional lifestyle. Weather related changes and changes in the traditional cycle of the seasons are affecting the lives of Alaska Native people. They are witnessing the arrival of new species of insects, plants and birds. The late freeze up and the early spring makes movement on the tundra and lakes difficult. There has been erosion caused by new, strong winds.

Enhancing our awareness of the changes requires balancing the scholarly approaches to understanding environmental changes with the indigenous systems of knowing. Alaska Native Elders maintain systems of knowledge which hold the potential to improve knowledge of climate changes by honoring and listening to their knowledge as equal partners with Western science.

Alaska Native are observing and being affected by Arctic change and they maintain a substantial amount of pertinent knowledge. Alaska Natives are stakeholders and need to be engaged in the definition of questions, participation in research and interpretation of the findings. Alaska Natives are facing a complex set of social, economic and cultural changes which are directly linked to environmental changes. Alaska Natives living in rural Alaska are dependent upon the earth for their survival. They practice a subsistence way of life. Hunting and gathering activities provide continuity between generations.

164. Greening of the Arctic: An Overview of the GOA-IPY Initiative

Donald Walker

One of the key goals of IPY is to characterize, monitor, and model the expected changes to terrestrial vegetation resulting from global warming. Changes in the biomass of terrestrial ecosystems will likely affect the permafrost, active layer, carbon reserves, trace-gas fluxes, hydrological systems, biodiversity, wildlife populations and the habitability of the Arctic. The Greening of the Arctic (GOA) initiative consists of a group of scientists who are part of four major components that will examine the spatial and temporal trends of greening in the Arctic, how these trends are affecting the indigenous people of the Arctic, and communicate the results of the study to students, scientists, government agencies, and the general public.

165. Biocomplexity of Patterned Ground

Donald Walker

We studied the interactions between frost-heave, contraction cracking, soil properties, and vegetation involved in the formation of small patterned ground features (non-sorted circles, non-sorted polygons, earth hummocks, and turf hummocks) along an 1800-km long transect in northern Alaska and Arctic Canada. The transect traverses 10° of latitude (Toolik Lake, 68° 37' N, to Isachsen, 78° 47' N) and approximately 11° C of mean July temperature. We established permanent monitoring sites at ten locations (Happy Valley, Sagwon, Franklin Bluffs, Deadhorse, West Dock, Howe Island, Inuvik, Green Cabin, Mould Bay, Isachsen) in all five bioclimate subzones of the Arctic (Subzone A is the coldest and subzone E is the warmest Arctic subzone.) There is a continuum of patterned-ground forms along the transect: Large well-vegetated earth hummocks 2-3 m in diameter are prevalent in forested areas and in tussock tundra areas of Subzone E. Partially vegetated and barren 1-2-m diameter non-sorted circles are dominant in subzones D and C, and small non-sorted polygons 10-30 cm in diameter related to contraction cracking are dominant in subzones B and A. The transect in Alaska traverses mainly silty loess soils with strong frost heave – up to 21 cm in the centers of nonsorted circles at Deadhorse. The maximum contrasts between the centers of patterned ground features and the undisturbed tundra between the features occurs in the northern part of the Arctic Coastal Plain of Alaska (northern Subzone D), where an abundance of soil water combines with ideal temperature, soil-texture, and vegetation conditions to produce extensive heave and needle-ice development in the centers of the non-sorted circles, whereas the areas between circles are well-vegetated with little heave. In areas with strong differential frost heave there is a large difference in the summer temperatures at the top of the mineral soil horizon of the centers of non-sorted circles compared to the inter-circle areas. This difference is related to the thickness of the plant and soil organic layers (virtually no vegetation in the centers of the circles compared to 10-20 cm of organic material between the circles). In winter in subzones C and D, there are also large temperature differences between the centers of features and the surrounding tundra especially in areas where the soil heaves significantly, resulting in thin snow layers above the patterned-ground features. Soil on sandy and glaciated landscapes in Canada have much less heave, generally less than 7 cm, even in the centers of patterned ground features. The heave in vegetated areas outside the frost features is much less and does not exceed 6 cm at any of the sites. Modeling the processes involved in small-patterned-ground formation focuses on the flow of heat and water within the features in relationship to the differential heat flux at the soil surface. The transect now provides a baseline of observations along the complete Arctic climate gradient including ecosystems at the cold extreme and should be considered for long-term observations and monitoring related to the International Polar Year.

166. The Effect of Discretionary Decision-Making on Alaska's Oil Exploration Season: A Case Study of Science Informing Policy Under Conditions of Climate Change and Variability

Sherri Wall

The influence of climate change and variability on oil exploration in Alaska has brought focus to the issue of the integration of best available science and technology (BAST) into natural resource decision-making. Prolifically cited as an indicator of rapid (decadal-scale) climate change, the length of the winter tundra travel season shrank from 200 days in the early 1970's to 100 days in 2003. The restricted operating window reduced oil exploration and drilling operations with implications to the fiscal stability of Alaska and the energy security of the United States. The Department of Natural Resources (DNR) bears responsibility for setting standards for evaluation and making the yearly determination of when tundra conditions are suitable to declare a "general opening" for winter exploration. Basing its decision on discretionary professional judgment, DNR has followed a heuristic 12-6 standard stipulating that the active layer be frozen to a depth of 12 inches and that 6 inches of snow accumulation be present to ensure protection of the tundra from exploratory activities. The primary thrust of this empirical research was to juxtapose temporally-relative scientific data alongside DNR's historic tundra opening dates determined via the ad hoc standard in an effort to determine the extent to which BAST informed policy. The findings of this study suggest that the discretionary decisions of the agency, rather than the climatic conditions, were the primary driver in increasingly diminished oil exploration seasons. The results underscore the importance of striving towards incorporating BAST in the policy process, and raise the question of how agencies holding responsibility for evaluating environmental change and issuing permits can best avoid spurious correlations.

167. Observed and Projected Change of Arctic Temperature and Pressure

John Walsh, William Chapman

Surface air temperatures have warmed and sea level pressures have decreased significantly over much of the Arctic over

the past half-century. Agreement/disagreement of observed changes with those simulated and projected by the global climate models (GCMs) provides fuel for the attribution/natural variability debate and can point toward model strengths and deficiencies. We summarize recent changes of temperature and pressure in the Arctic by month and season as observed for various datasets and record lengths. We also summarize corresponding changes in temperature and pressure output from a recent set of 14 GCM simulations from the IPCC Fourth Assessment. The GCM simulations, forced by observed and projected scenarios of increasing greenhouse gas concentrations, show considerable variability from one model to the next and even between two or more ensemble simulations from the same GCM. While there is general GCM agreement with observed changes in the poleward amplification of the warming and pressure decreases, the spatial patterns of change show considerable disagreement. GCMs, for example, simulate the largest changes in surface air temperature over perennial sea ice covered regions of the Arctic ocean. The largest observed changes to date, however, have been confined to the Northern continental regions of the Arctic. Seasonally, both observed and simulated changes are largest in the winter and smallest over the summer Arctic ocean. The agreement between annual cycles of observed and GCM-simulated change is higher in the Arctic than anywhere else on the globe. We place these recent observed and simulated changes in context of the projected changes of temperature and pressure for the next century. All models project a 21st century warming that is largest in the autumn and winter, although the rates of projected warming vary considerably among models. Negative changes of sea level pressure are projected over essentially the entire Arctic for the next century. The most significant decreases of pressure over the 21st century are projected for the Bering Strait region, primarily in the autumn and winter. Interestingly, observed decreases in pressures over the past half-century over the Bering Sea have decreased more than any other place on the globe, but simulations for the past half-century by the GCMs show a much more modest change.

168. The Recent Retreat of Summer Sea Ice

John Walsh, Lawson Brigham, William Chapman

Summer sea ice cover is both a high leverage component of the global climate system and an integrated signal of recent climate change. Diverse impacts from the year-to-year variability of the summer ice edge vary from whale migratory routes to shipping navigation interests. We summarize recent changes in Northern Hemisphere summer sea ice extent by presenting spatial maps of the ice coverage at the time of the ice minimum in each year of the 1979-2005 satellite period. While the ice coverage in a particular subpolar sea shows substantial interannual variation, an outstanding feature of the recent several years is the poleward retreat of the southern ice edge. The four most extreme minima of ice area in the entire period of record occurred in 2002, 2003, 2005 and 2004. Similarly, three of these years – 2002, 2004 and 2005 – provided the most extreme minima of ice extent. In particular, 2005's minimum ice extent set a new record for the least ice extent in the Arctic during the period of record and current sea ice anomalies for July, 2006 appear to be at least as low as those in 2005. Fitted linear trends from timeseries of ice extent and ice area show decreases of 23% and 27%, respectively: ice extent has decreased from 6.9 million km² in 1979 to 5.4 million km² in 2005, while the corresponding decrease of ice area was from 5.2 million km² in 1979 to 3.8 million km² in 2005. An index created to loosely indicate the navigability of the Arctic ocean, defined as the number of days with ice area below 7 million km², has increased from about 50 days to nearly 80 days. This increase in length of open water season is even larger than projected rates of increase of the Northern Sea route navigation season, which according to ACIA (2005) show trends of between 5 and 10 days per decade (depending on a vessel's ice capability). Similarly, recent patterns of Northern Hemisphere sea ice extent at the annual minima are most similar to corresponding extent projections by ACIA GCMs for the year 2020.

169. Teachers and Researchers Exploring and Collaborating (TREC)

Janet Warburton, Wendy Warnick, Helen Wiggins, B. Zeb Polly, Sarah Behr

In Teachers and Researchers Exploring and Collaborating (TREC), K-12 teachers participate in arctic field projects, working closely with researchers to improve science education through experiences in scientific inquiry. TREC builds on the scientific and cultural opportunities of the Arctic to link research and education through topics that naturally engage students and the wider public. In addition to arctic field research experiences, TREC supports teacher professional development and a sustained community of teachers, scientists, and the public through workshops, Internet seminars, an e-mail listserve, and teacher peer groups.

TREC immerses teachers in scientific research across the Arctic. The program enables teachers to work side-by-side with researchers on arctic field projects investigating topics such as tundra and wildlife ecology, marine biology,

atmospheric chemistry, and long-term climate change. Locations of field sites vary - TREC teachers participate in arctic research aboard the U.S. Coast Guard Cutter Healy in the Arctic Ocean; at scientific research stations on the Alaskan tundra, the Greenland Ice Sheet, and in the Svalbard Archipelago; at remote field camps in Russia; and at numerous other arctic locales.

While in the field, teachers and researchers communicate extensively with their colleagues, communities, and hundreds of students of all ages across the globe, using a variety of tools including satellite phones, online journals, and interactive "webinars" (web-based seminars). The online outreach elements of the project convey these experiences to a broad audience far beyond the classrooms of the TREC teachers.

Currently in its third year, TREC is funded by the National Science Foundation Office of Polar Programs and managed by the Arctic Research Consortium of the United States (ARCUS) with logistical support from VECO Polar Resources.

Researchers, educators, classrooms and the public are encouraged to visit the TREC website: www.arcus.org/trec to learn more about calls from the field, online message boards and presentations, photo albums, and learning resources. For further information, contact Janet Warburton, ARCUS Project Manager, at warburton@arcus.org or 907-474-1600.

170. Adaptations to Hibernation: NMDA Receptor Expression and Phosphorylation

James Warner, Barbara Taylor

Mechanisms underlying the physiological adaptations to mammalian hibernation are poorly understood. Tolerance of repeated hypoxia-ischemia (HI) events is an inherent component of hibernation, as is an increased capacity for neural growth and plasticity. These characteristics are not exhibited by most adult mammals, but are exhibited by mammalian neonates. It has been proposed that adaptations to hibernation arise through the re-expression of neonatal characteristics in adult hibernators. N-methyl-D-aspartate receptors (NMDARs), a subset of excitatory glutamate receptors that facilitate Ca²⁺ entry into cells, are abundant throughout the central nervous system (CNS). The function of NMDARs changes with subunit expression and phosphorylation state. They are central to neural development, plasticity, excitotoxicity, and degeneration, and they serve a critical function in numerous physiological and pathological processes. Importantly, NMDARs are believed to be involved in the mediation of HI-induced neuronal apoptosis and regulation of neural networks by mediating synaptic plasticity and neurodegeneration. Understanding the link between subunit expression and phosphorylation state is prerequisite to understanding basic principals influencing synaptic transmission in the CNS, and has been widely recognized as a key to therapeutic interventions in numerous human diseases and conditions. Our study investigates the roles that NMDAR subunit expression and phosphorylation state play in avoiding HI-induced neuronal apoptosis in the Syrian hamster (*Mesocricetus auratus*), a facultative hibernator. This ongoing project will provide a spatial and temporal map of NMDAR subunit expression and phosphorylation state relative to a hibernation cycle and will couple this map with measured changes in NMDAR function over the hibernation cycle. The project also assesses the possibility that the capacity for hibernation in some adult mammals is a re-expression of neonatal traits common to all mammals. Current results will be discussed.

171. The Arctic Research Consortium of the United States (ARCUS)

Wendy Warnick

The Arctic Research Consortium of the United States (ARCUS) is a nonprofit membership organization composed of universities and institutions that have a substantial commitment to research in the Arctic. ARCUS was formed in 1988 to serve as a forum for planning, facilitating, coordinating, and implementing interdisciplinary studies of the Arctic; act as a synthesizer and disseminator of scientific information on arctic research; and educate scientists and the general public about the needs and opportunities for research in the Arctic. ARCUS promotes arctic research by improving communication among the arctic research community, by organizing workshops, and by publishing scientific research plans. In addition, ARCUS acts as a liaison between the arctic research community and policy makers through activities such as monitoring relevant legislation, providing science policy information to the research community, and responding to inquiries by agency and congressional staff concerning arctic science.

172. Community Needs Assessment and Portal Prototype Development for an Arctic Spatial Data Infrastructure (ASDI)

Wendy Warnick, Helen Wiggins, Lamont Hempel, Jordan Henk, Mark Sorensen

As the creation and use of geospatial data in research, management, logistics, and education applications has proliferated, there is now a tremendous potential for advancing science through a variety of cyberinfrastructure applications, including Spatial Data Infrastructure (SDI) and related technologies. SDIs provide a necessary and common framework of standards, securities, policies, procedures, and technology to support the effective acquisition, coordination, dissemination and use of geospatial data by multiple and distributed stakeholder and user groups. Despite the numerous research activities in the Arctic, there is no established SDI and, because of this lack of a coordinated infrastructure, there is inefficiency, duplication of effort, and reduced data quality and search ability of arctic geospatial data. The urgency for establishing this framework is significant considering the myriad of data that is likely to be collected in celebration of the International Polar Year (IPY) in 2007-2008 and the current international momentum for an improved and integrated circumarctic terrestrial-marine-atmospheric environmental observatories network. The key objective of this project is to lay the foundation for full implementation of an Arctic Spatial Data Infrastructure (ASDI) through two related activities: (1) an assessment—via interviews, questionnaires, a workshop, and other means—of community needs, readiness, and resources, and (2) the development of a prototype web mapping portal to demonstrate the purpose and function on an arctic geospatial one-stop portal technology and to solicit community input on design and function. The results of this project will be compiled into a comprehensive report guiding the research community and funding agencies in the design and implementation of a robust ASDI.

173. High Arctic Surface & Feedback Processes: Attributes, Responses and Changes in State

Jeffery Welker, Ronald Sletten, Bernard Hallet, Josh Schimel, Heidi Steltzer

Terrestrial landscapes in the High Arctic (those north of 70°) constitute a significant portion of the Arctic. This region is undergoing some of the most visible and dramatic changes associated with climate warming including; a) ice sheet thinning, b) exceedingly warm temperatures and c) episodic extreme rain events. Because of their remoteness, and limited access; surface and ecosystem processes studies that examine physical processes, hydrologic & chemical dynamics and terrestrial ecosystem responses to changes in summer and winter conditions have been few, curtailing our holistic understanding of the Arctic. For the past four years we have been investigating the attributes, responses and physical-chemical-biological interactions that control carbon and water dynamics in NW Greenland. We have found that: a) non-linearities exist regarding tundra responses to multiple levels of experimental warming, b) warmer temperatures combined with greater summer rainfall control soil temperatures at depth and are conditions most conducive to higher rates of summer N mineralization and soil respiration, c) nutrient limitations constrain surface and feedback processes, d) polar stripe formation along hillslopes and cryoturbation buries soil carbon at depth and explains our dramatic underestimation of soil carbon pools in the High Arctic, e) detecting vegetation changes with remote sensing that are manifested in increases in LAI need to account for species-specific NDVI-LAI relationships, and f) hydrological processes linking the Greenland Ice Sheet to Baffin Bay are primarily controlled by snow melt and not rain water inputs. High Arctic landscapes will continue to be sensitive barometers of changes in the state of the Arctic while surface and feedback processes will be controlled by the interactions between physical-chemical and biological processes.

174. Examining Adaptive Capacity from the Inside Out: A Multi-Scale Analysis for Assessing Capacity in Northern Communities

Sonia Wesche, Derek Armitage

Building the capacity of communities to adapt to changing conditions is increasingly important in dynamic northern environments experiencing extensive resource development and climate change. Assessments of adaptive capacity in such situations of rapid change, however, must be sensitive to cross-scale effects. In small, resource-dependent communities, local-level assessments of adaptive capacity should be complemented by evaluations of regional and national level influences. In this paper, we highlight the importance of a scale-sensitive analysis of adaptive capacity and the value of examining adaptive capacity from the inside out, based on our experiences in the community of Fort Resolution, Northwest Territories. At the local level, our analysis places particular emphasis on the relationship among adaptive capacity and the features of social organization that facilitate collaboration and cooperation for mutual benefit, such as networks, norms and social trust (i.e., social capital). We nest this local-scale analysis of adaptive capacity, however, in the wider socio-political and institutional context of the North, drawing attention to the manner in which

emerging institutions, land claims processes and governance models (e.g., co-management) can have a profound influence on the ability of communities to proactively respond to intensive resource development and environmental change. Our analysis is based on interviews and focus groups with elders and subsistence harvesters, a questionnaire administered to 103 heads of household in the community, and key informant interviews with a range of community-based and regional leaders and government officials. This study provides an example of a multi-scale analysis of adaptive capacity; the approach may be usefully adapted to other communities in the North (and elsewhere) that are confronting complex issues of biophysical and socio-economic change.

This research is supported by an Undergraduate Student Project Award from Alaska INBRE.

175. Coastal Plain and Brooks Range Foothills Water Resources

Daniel White, Douglas Kane, Michael Lilly, Sveta Berezovskaya, Horacio Toniolo, Daqing Yang, Molly Chambers, Ken Irving, Robert Busey, Peter Prokein

Water resources are limited in many areas of the North Slope, Alaska, particularly during mid-winter operations. Water is used both for ice road construction and maintenance, drilling and facility operations, and potable water supplies. The coastal plain area between the Sagavanirktok River and Bullen Point has numerous shallow lakes, but further south in the northern foothills of the Brooks Range, lakes are fewer. Deeper natural lakes as well as gravel pits can serve as water resources and fish habitat. Proper management therefore requires understanding of hydrological and chemical impacts of water removal. Snow on the North Slope of Alaska lasts up to nine months a year. Water contained in snowpack ensures that snowmelt is a major hydrological event each year. Peak discharge resulting from snowmelt is the highest for many rivers on the North Slope, particularly for the largest basins like the Colville, Sagavanirktok and Kuparuk Rivers. Rivers flowing into the Beaufort Sea drain a large area that extends from the Brooks Range through the Northern Foothills and across the Coastal Plain before discharging into the Arctic Ocean. The data on water content of snowpack at the end-of-winter have been collected in the basins of the Central Alaskan Arctic. Combined studies of hydrology and lake chemistry are underway. Data for hydrological modeling is being collected with newly installed meteorological stations and field measurements of snow depth and snow water equivalent were taken in late winter, 2006. Data on natural lakes and gravel pit reservoirs were also collected in late winter, 2006, including lake depth and ice thickness, plus profiles of dissolved oxygen, electrical conductivity, temperature, pH, and oxidation reduction potential. Minimal under-ice water is available in natural lakes in the region, but gravel pits could potentially serve well as reservoirs and fish habitat, as adequate dissolved oxygen persisted through to the end of winter in much of the water column of sampled pits. This paper presents an overview of current data gathering and modeling efforts.

176. Effects of Nutritional Restriction on Stable Carbon and Nitrogen Isotopes in Tufted Puffin Nestlings: Implications for Assessment of Diet and Body Condition

Cory Williams, Justine Sears, Alexander Kitaysky, C. Loren Buck

Analysis of $^{12}\text{C}/^{13}\text{C}$ and $^{14}\text{N}/^{15}\text{N}$ stable isotopes in animal tissues provides a useful means of delineating dietary sources, determining trophic level of feeding and tracking migratory movements. However, interpretation of isotope data may be complicated by effects of nutritional status on biochemical pathways and physiological processes, although few experimental studies have addressed this issue. The current paradigm in stable isotope ecology holds that tissues in animals subjected to nutritional restriction become enriched in ^{15}N due to catabolism of body proteins, increased recycling of metabolic amino acid pools, and nitrogen fractionation associated with deamination and/or transamination of amino acids. We investigated the effects of nutritional restriction on $^{12}\text{C}/^{13}\text{C}$ and $^{14}\text{N}/^{15}\text{N}$ stable isotopes in two captive experiments using wild caught and laboratory hatched tufted puffin nestlings. Tufted puffins are a species that exhibits both physiological and metabolic compensatory responses to nutritional limitation including down-regulation of corticosterone, a steroid that promotes catabolism of endogenous protein stores. Contrary to previous studies, we found that nutritionally restricted tufted puffin nestlings had whole blood and red blood cells significantly depleted in ^{15}N and ^{13}C compared to well-fed conspecifics. Furthermore, nestlings fed ad libitum became progressively more enriched in ^{15}N and ^{13}C during development, suggesting recycling of metabolic carbon and nitrogen increases with body size. Our findings have important implications for isotopic analyses of diet and/or physiological condition in free-living animals.

177. Lessons Learned from the First International Polar Year, 1882-1883

Kevin Wood, James Overland

A unique glimpse of the circumpolar Arctic environment from a period before the present era of climate change and global observations is found in the records of the first International Polar Year of 1882-1883. Inspired by the Austrian scientist and explorer Carl Weyprecht, the purpose of the International Polar Year was to discover the fundamental laws governing global meteorological and geophysical phenomena through a program of simultaneous observations that encompassed the Polar Regions. The field program was successfully completed, but afterwards the data fell into obscurity. The synthesis envisioned by Weyprecht was never undertaken. The first analysis of synchronous meteorological observations recorded during the International Polar Year shows that surface air temperature and sea-level pressure were within limits of recent climatology but exhibited a wide range of spatial and temporal variability, a pattern typical of the Arctic climate today. Monthly average temperature, sea-level pressure, and associated phenological anomalies were regionally coherent, consistent with the North Atlantic Oscillation and Pacific patterns of variability. Barrow, for example, showed a strong storm-driven Pacific influence in February. Two expedition ships were trapped in heavy ice in the Kara Sea where it is nearly ice-free today. These results demonstrate the usefulness of synoptic data in understanding the evolution of the climate and ecosystems in the Arctic. And while the first International Polar Year established a successful precedent for future international scientific cooperation in the Polar Regions, its unrealized promise highlights the importance of post-expedition synthesis and the effective preservation and analysis of valuable historical data.

178. POLARities Exhibit Artist Presentation

Kesler Woodward

The artist talks about the affinities and differences between popular notions of scientific and artistic ways of seeing and investigating the world, suggesting that while there are differences, they are in fact less pronounced than is commonly believed.

179. Coastal Runoff Supplies Major Source of Iron to the Algal Community Growth in the Northern Gulf of Alaska

Jingfeng Wu, Rob Rember

Iron limitation of algal growth has been demonstrated in coastal and oceanic upwelling systems where available Fe mainly derives from Fe-rich subsurface water and shelf/slope sediments, in contrast to the atmospheric deposition as the major Fe source for the subtropical oligotrophic gyres. Riverine and coastal fresh water Fe inputs have not been considered to substantially influence coastal upwelling high productivity system because of the coagulation and precipitation loss of Fe during the mixing of fresh water with saline water. Here we present the distribution of size fractionated Fe concentrations in the Northern coastal Gulf of Alaska to show that coastal plumes of low salinity water from Alaska coast can be a major source of iron to sustain high productivity in this region. This Fe source was able to influence over large area of the GOA as the low salinity water floats on the sea surface and is transported far from the coast line during maximum coastal fresh-water discharge. The high biological productivity can be maintained by the mixing of the high Fe fresh water run-off with low Fe high nitrate GOA basin water.

180. Thompson Drive Permafrost Cooling Systems

Jianfeng Xu, Douglas Goering

In 2003, a new road building project started near Fairbanks, Alaska. The project (now known as Thompson Drive) contains three different types of passive cooling systems aimed at maintaining the thermal stability of underlying permafrost. The cooling systems utilize both air convection embankment (ACE) layers and two-phase thermosyphons in three different configurations. Probes were installed in three road sections to record the thermal performance of the cooling system and the natural ground beneath the embankments. This poster describes the instrumentation system and presents performance results for the first year of operation.

181. The Genetic Diversity of a Collared Pika (*Ochotona collaris*) Population from the Southwest Yukon Revealed using Ten Microsatellite Markers.

Jessie Zgurski, David Hik

The collared pika (*Ochotona collaris*) is a small lagomorph that inhabits alpine talus slopes in northwestern North America. Since collared pikas live on naturally fragmented talus slopes and have rarely been observed to disperse distances of over one kilometer, populations are likely to exhibit subdivision at very fine scales. We examined the genetic structure of a collared pika population inhabiting a four km² valley in the southwest Yukon to determine if the population was genetically structured. This was accomplished by genotyping three hundred twenty-four pikas caught between 1995 and 2005 using ten polymorphic microsatellite markers. Contrary to our expectations, populations separated by wide sections of unsuitable meadow habitat within the valley displayed little genetic differentiation, indicating that frequent dispersal among the populations is likely. However, genetic diversity in the population declined after the population underwent a bottleneck in 2000. Populations of alpine pikas are declining throughout North America and Asia, and this is hypothesized to be the result of global climate change.

182. Vegetation Changes and Climatic Consequences in Northern High Latitudes

Jing Zhang, John Walsh

Satellite remote sensing data indicates that greenness has been increasing in the northern high latitudes, apparently in response to the warming of recent decades. In order to identify feedbacks of this land cover change to the atmosphere, we employed the atmospheric general circulation model ARPEGE-CLIMAT to conduct a set of control and sensitivity modeling experiments. In the sensitivity experiments, we increased the greenness poleward of 60°N by 20% to mimic the manifestation of vegetation changes in the real world, and by 60% and 100% to represent potential aggressive vegetation change scenarios under global warming. In view of the direct exposure of vegetation to sunlight during the warm seasons, we focused our study on the results from late spring to early fall. Our results revealed significant thermodynamic and hydrological impacts of the increased greenness in northern high latitudes, resulting in a warmer and wetter atmosphere. Surface and lower tropospheric air temperature showed a marked increase, with a warming of 1-2°C during much of the year when greenness is increased by 100%. Precipitation and evaporation also showed a notable increase of 10% during the summer. Snow cover decreased throughout the year, with a maximum reduction in the spring and early summer. The above changes are attributable to the following physical mechanisms: (1) increased net surface solar radiation due to a decreased surface albedo and enhanced snow-albedo feedback as a result of increased greenness; (2) intensified vegetative transpiration by the additional plant cover; and (3) reduced atmospheric stability leading to enhanced convective activity. The results imply that increased greenness is a potentially significant contributing factor to the amplified polar effects of global warming.

183. A Coupled Ice Ocean Model Focus on the Arctic

Sheng Zhang, Jia Wang

The ice code of IARC regional CIOM (Coupled Ice-Ocean Model, Wang et al., 2005) is being replaced by the CICE ice model version 3.1 which has 4.5 vertical layers and 5 ice thickness categories, as well as the increment remapping advection scheme. The coupling scheme is based on the NCAR Flux Coupler 5, which uses MPI directly, and the ice model and ocean model (based on POM) run as separated programs. This coupling method thus has the advantage as a plug-in tape of the code, which will be easily coupling to a different ocean model. We will present the primary comparison of the results from the two versions of the coupled models, and will discuss the underlying physics of the two models.

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Arctic Division
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P. O. Box 80271 • Fairbanks, AK 99708
Tel.: 907.474.7525 • Email: fychem@uaf.edu
www.arctic.aaas.org